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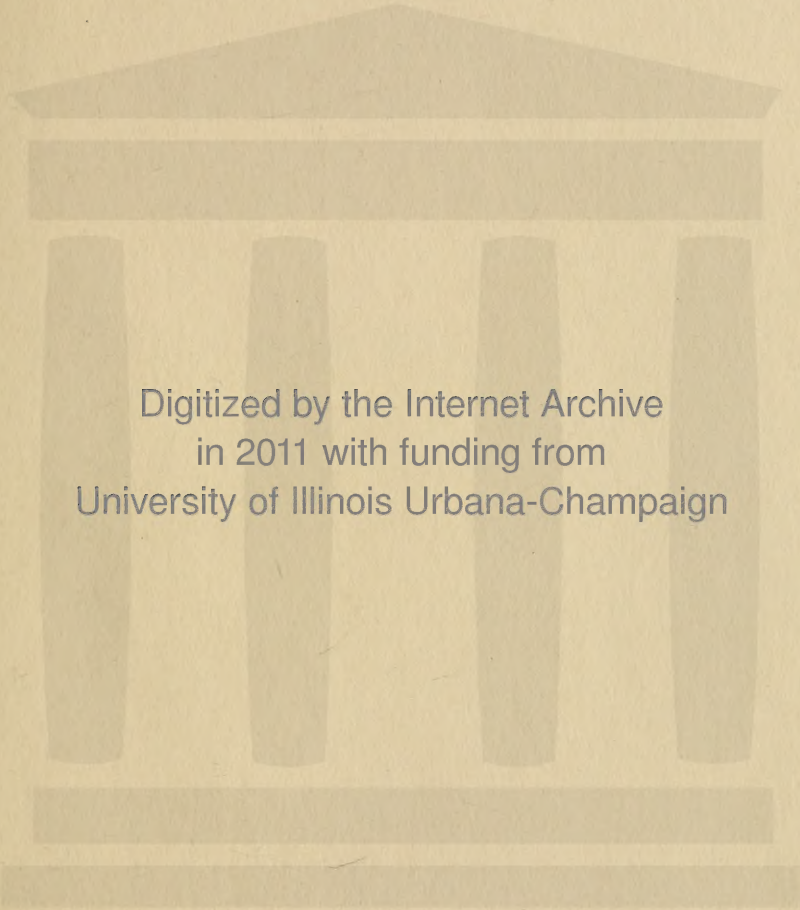
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# ILLINOIS BIOLOGICAL MONOGRAPHS

VOLUME XIX

PUBLISHED BY THE UNIVERSITY OF ILLINOIS

URBANA, ILLINOIS





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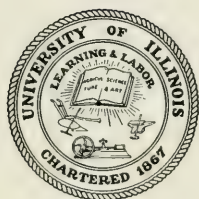




# ILLINOIS BIOLOGICAL MONOGRAPHS

Vol. XIX

No. 3



PUBLISHED BY THE UNIVERSITY OF ILLINOIS  
UNDER THE AUSPICES OF THE GRADUATE SCHOOL  
URBANA, ILLINOIS

EDITORIAL COMMITTEE

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THE GENUS CONOTRACHELUS DEJEAN  
(COLEOPTERA, CURCULIONIDAE)  
IN THE NORTH CENTRAL  
UNITED STATES

WITH NINE PLATES

BY  
HERBERT FREDERICK SCHOOF

CONTRIBUTION FROM THE ENTOMOLOGICAL LABORATORIES OF THE  
UNIVERSITY OF ILLINOIS  
No. 223

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## PREFACE

The greater portion of the material included in this study has been taken from a thesis of the same title, submitted in partial fulfillment of the requirements for the degree of Doctor of Philosophy in Entomology in the Graduate School of the University of Illinois, 1940. The original material has been revised, and several additions have been made.

The author wishes to express his sincerest thanks to Professor W. P. Hayes, of the Department of Entomology, University of Illinois, under whose supervision this study was conducted. Professor Hayes suggested the problem and throughout the study has furthered its progress by his many helpful criticisms. He has given unstintingly of his time, and has also placed at the writer's disposal his excellent personal collection of *Conotrachelus*. It is with pleasure that the author names a new species, *C. hayesi*, in his honor.

Much credit is due Mr. L. L. Buchanan, of the United States National Museum, who has given generously of his time to discuss with the writer the problems involved in the genus, and who has been of much assistance during the entire course of the study. Mr. Buchanan has informed the writer of several morphological characters of taxonomic value in the genus, has arranged for specimen loans from the National Museum, and has assisted the writer in innumerable ways. The writer takes pleasure in naming a new species, *C. buchanani*, in his honor.

The author also wishes to express his appreciation to Dr. C. L. Metcalf and Dr. W. V. Balduf, of the Department of Entomology, University of Illinois, for their interest and kind cooperation in this problem; to Dr. P. J. Darlington, Jr., Museum of Comparative Zoology, Cambridge, Massachusetts, for comparison of specimens with the J. L. Leconte types, and for the many courtesies which he extended to the writer during his visit in Cambridge; to Dr. E. C. Van Dyke, of the Department of Entomology, California Academy of Sciences, for comparison of specimens of *Conotrachelus naso* Lec. with the type of *C. cinereus* Van Dyke; to Dr. Z. P. Metcalf and Dr. T. B. Mitchell, of the Department of Zoology and Entomology, North Carolina State College, for the facilities which made it possible to revise the original manuscript; and to Mr. H. S. Barber, of the United States National Museum, for information concerning the nomenclature of the genus *Conotrachelus*.

Only through the kind cooperation of numerous individuals were the necessary specimens procured for this study. To the following, the writer is indebted for specimen loans: Dr. H. H. Ross, Illinois State Natural History Survey; Dr. C. L. Fluke, University of Wisconsin; Dr. H. E. Jaques, Iowa Wesleyan College; Dr. L. Haseman, University



of Missouri; Dr. P. O. Ritcher, University of Kentucky; Mr. W. J. Gerhard, Field Museum of Natural History; Dr. C. E. Mickel, University of Minnesota; Mr. C. A. Frost, Framingham, Mass.; Dr. Marion E. Smith, Massachusetts State College; and Dr. C. S. Brimley, Division of Entomology, North Carolina Department of Agriculture.

The writer also wishes to thank Dr. R. C. Smith, of Kansas State College, and Dr. Clay Lyle, of Mississippi State College, for their assistance in securing biological data.

*Raleigh, North Carolina*

H. F. S.

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## I. INTRODUCTION

The genus *Conotrachelus* Dejean embraces over 930 known species, all of which are confined to the Americas. The majority of these species occur in South and Central America, 54 species being known from the United States and Canada. In spite of the relatively large number of species in this region, little taxonomical or morphological work has been done on the genus other than that included in general considerations of the Rhynchophora. Biological data have been accumulated on many of the species, but, as will be pointed out later, the significance of some of these data is questionable because of specific confusion. Consequently, a taxonomic revision of the genus would seem to be of definite value.

The investigations reported here have a threefold purpose; first, to prepare workable keys to, and descriptions of, the species of *Conotrachelus* occurring in Illinois and the surrounding states of Wisconsin, Iowa, Missouri, Kentucky, and Indiana; second, to study the morphology of the male genitalia and determine their taxonomic significance; and third, to evaluate the morphological characters previously used in the classification of this genus, and, if possible, to indicate additional ones. The majority of the species found in this middlewestern area are present over the eastern half of the United States, and the classification herein will, in general, apply to this eastern area.

## II. REVIEW OF LITERATURE

The taxonomic literature on the genus *Conotrachelus* has been confined to considerations in comprehensive works on the Rhynchophora and to descriptions of new species.

Dejean (1835) erected the genus *Conotrachelus*, but merely listed the species included. Schönherr (1837) was the first to bring together in a descriptive manner the known species of *Conotrachelus*. Of the sixty-five species discussed in Schönherr's *Genera et Species Curculionidum*, twelve occurred in the United States, and the remainder were from South or Central America. A key was given by Schönherr in which the final designation was to groups of species instead of to one species. The genus and many of the species were described in detail, but the majority of the descriptions were by Boheman and Fahreus, Schönherr having discussed only the generic characteristics. Most of the species were accredited to prior workers, but subsequent study has shown that many of these were *nomina nuda*; consequently, many new species were erected unknowingly. In 1845 Schönherr published another work on this genus, including at that time 106 species, of which thirteen were from the United States.

Leconte (1876) was the first American author to discuss the genus *Conotrachelus*. He separated it into four divisions, Division I consisting of parts A and B. In the appendix of the same publication Leconte amended his Division I, subdividing part B into two sections. The characters used to erect these groups are similar, except for modifications, to those used by the writer (p. 40). Leconte discussed twenty-four species in the text of his work, eleven of which were new. In the appendix, he described one other new species and stated that *plagiatus* n. sp. (p. 233) was a synonym of *nivosus* n. sp. (p. 229). The majority of the remaining thirteen species were redescribed, but several of them, such as *anaglypticus* (Say) and *leucophaeatus* Fahr., were only briefly mentioned. Leconte did not give any biological data, his discussion being confined to taxonomy and nomenclature.

Champion (1904) published the most comprehensive work on this genus, but his study, with the exception of four species, *posticatus* Boh., *leucophaeatus* Fahr., *anaglypticus* (Say), and *serpentinus* (Klug), was mainly concerned with the Central American fauna. Champion discussed 188 species, the majority of which were new. The characters of previously described species were briefly mentioned and each new species was fully described. The descriptions and discussions of the species were in numerous instances supplemented by figures, many of which were colored. The type of key employed was similar to that of Schönherr, the final designation being to a group of species. Champion's key, however, was condensed in a unit instead of being scattered through the text as was the case with Schönherr's.

Blatchley and Leng (1916) considered those species of *Conotrachelus* east of the Mississippi, treating twenty-eight, one of which was new. These authors followed Leconte's subdivisions of the genus, except that they listed them as Groups I to VI. All the species were redescribed and biological and distributional data were given.

The most recent treatment of the genus is that by Mutchler and Weiss (1925).<sup>\*</sup> These workers brought together the available biological data on the sixteen species occurring in New Jersey and discussed briefly the genus and these species, including a descriptive key to the latter. This paper is of much value for its biological discussions.

The six previously mentioned treatments are the only comprehensive works pertaining to the entire genus. Other references, briefly discussed below, are limited to descriptions of new species or to one section of the genus.

<sup>\*</sup>Dr. T. D. A. Cockerell, in Science, Vol. 92, No. 2397, December 6, 1940, reviews a British Museum Publication by K. Fiedler, entitled, "Monograph of the South American Weevils of the Genus *Conotrachelus*," February, 1940, 365 pages. According to the reviewer, this monograph treats approximately 600 species, of which 416 are new. It is well illustrated and is published in German. The writer, as yet, has been unable to examine a copy of this monograph; consequently, it is not mentioned in the review of literature.

The earliest description of a species of *Conotrachelus* was that of *nemuphar* by Herbst (1797).<sup>\*</sup> Germar, another European worker, described *aratus* in 1824. Say (1831), the first American author accredited with species of *Conotrachelus*, described *retentus*, *cribricollis*, *anaglypticus*, and *elegans*. Walsh (1864), Leconte (1878), and Casey (1892, 1910) also described new species. Schaeffer (1904, 1906) published descriptions of five new species and included in the 1906 paper a key to all the known species of Leconte's Division 1-A. Recent describers of new North American species have been Fall (1907, 1913, 1917, 1929), Blatchley (1917), and Van Dyke (1930). Buchanan (1937) published the synonymy of *C. atokanus* Fall and *Loceptes recessus* Casey.

The genus *Conotrachelus* and its species have also been considered in numerous catalogues. Dejean (1835, 1837) in his catalogue listed seventy-one specific names, of which sixty-seven were *nomina nuda*. Henshaw (1885, 1895) listed twenty-eight species north of Mexico in 1885, and in his Third Supplement (1895) added six more. Leng (1920) listed forty-eight species north of Mexico, and in his Second Supplement (1933) increased the total to fifty-three. The most recent catalogue is that by Hustache (1936), in the *Coleopterorum Catalogus* of Junk and Schenkling, in which fifty-four North American species are listed. While Henshaw and Leng considered only the North American species and their synonymy, the *Coleopterorum Catalogus* deals with all species of *Conotrachelus* and includes references to biological data as well. Several names are shown to be preoccupied, and new ones are substituted. The Leng catalogue and supplements, however, are the most reliable sources for references to original descriptions and distributional data. In the *Coleopterorum Catalogus*, the distribution of certain American species known from only one locality is frequently given as "*Etats Unis*." Some Cuban species also are erroneously reported as occurring in the United States. This catalogue, however, is preferred for biological references.

Most of the species mentioned in this review of literature, excepting those treated by Leconte (1876) and Blatchley and Leng (1916), are indigenous to the Gulf Coast States and the southwestern area. Consequently, this treatment of the species in the midwestern area will be principally concerned with those species discussed by Leconte (1876) and Blatchley and Leng (1916). Further references to these two works will be found under the discussions of the individual species.

The morphological literature is discussed under the section on morphology, and the nomenclatural references are included in the section on nomenclature.

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<sup>\*</sup>All species before 1835 were placed in allied genera, as the genus *Conotrachelus* was not erected until that date.



## III. MATERIALS AND METHODS

A. THE REMOVAL, STUDY, AND PRESERVATION  
OF THE MALE GENITALIA

The initial step in the dissection of the male genitalia is the removal of the abdomen, since with museum specimens it is very difficult, if not impossible, to dissect out the genitalia with the abdomen *in situ*. Before this is attempted, however, the specimen should be relaxed, as it is desirable that the specimen be fully pliable before being handled. For manipulation, the insect, when unpinned is best held between the thumb and forefinger. The fingers possess a certain amount of pliability which cannot be obtained with forceps; the latter frequently slip and cause the insect to be violently expelled. With the specimen in place, a sharply pointed, flattened needle is gradually inserted between the abdomen and the metacoxa. When the needle enters the coxal cavity it is slowly turned so that the flattened point acts as a lever forcing the abdomen to separate from the metacoxae and the metasternum. The needle is then moved medially to sever the connecting tissues and to further separate the abdomen from the metasternum. In some instances only one manipulation of the dissecting needle is necessary; in others several different insertions may be required. While removing the abdomen the specimen should be held firmly so that the elytra do not become disengaged; otherwise they may become permanently "sprung."

The removed abdomen is placed in a cold solution of concentrated potassium hydroxide, the period of immersion in this solution varying with the specimen, the larger ones requiring approximately one hour, the smaller ones thirty minutes. It is best to soak the abdomen in potassium hydroxide only until the muscles have softened, rather than until they have broken down completely, since the length of time necessary for muscular disintegration may lead to undesirable softening effects upon the genitalia.

After removal from the potassium hydroxide solution, the abdomen is washed in water and placed in a few drops of water upon a slide. With the dorsal surface of the abdomen upwards, a needle is placed basally within the body cavity to hold the structure in position. When secure, a lengthwise incision is made along each side of the dorsum at its line of junction with the pleural region. The latter is heavily sclerotized, while the first six terga are membranous. The seventh and eighth terga, however, are sclerotized and fit tightly against the pleura (see Fig. 10), so progress in cutting here is slow and difficult. Care must be taken at these points to keep the cutting instrument as near to the pleura as possible, since the male genitalia lie close to the lateral walls of the seventh and eighth terga. When the incisions have been completed, the dorsum, genitalia, and eighth sternum may be removed in mass from

their normal position. Muscles and intestine are then removed and the genitalia may be easily seen attached to the eighth segment. Since they are fastened to the body wall by a membrane (Fig. 8, 1st connecting membrane), this must be severed both dorsally and ventrally to release the genitalia. Once the membrane is cut the genitalia are free and can be removed to a storage vial.

The technique discussed above was the one usually employed, but in many cases digressions from it were necessarily made, depending on the condition of the specimen to be dissected. Sometimes it was not necessary to remove the dorsum completely, but merely to sever it half-way and then by pressure upon the genitalia to force them outward. Occasionally potassium hydroxide was not employed, especially with freshly-emerged specimens where the genitalia already were soft. Other variations in the method occurred repeatedly because of the differences in the age, size, and condition of the specimens.

After the genitalia have been removed, the dorsum is replaced on the sclerotized sterna and pleura of the abdomen. The entire abdomen is then allowed to dry, and the dorsum upon drying adheres firmly to the sterna and pleura. Following this, the abdomen with its ventral surface upwards is fastened by an adhesive to the card point bearing the specimen. In this position the punctation of the abdominal sterna is readily accessible for study. The abdomen may be replaced in the specimen, but this is difficult and damage to the specimen may result. Such replaced abdomens cannot be fastened as securely as they can be on card points and they may later drop off.

The genitalia were temporarily stored in vials in a solution of 70% ethyl alcohol or in a three-to-one mixture of 70% alcohol and glycerine. The former was preferred since it did not show the tendency to "creep" up the sides of the vials as did the mixture of alcohol and glycerine.

Genitalia to be studied comparatively were placed in glycerine-filled depression slides which had perpendicular wells. For drawing and detailed study of the genitalia a syracuse watch glass half-filled with paraffin was used. A layer of glycerine or alcohol was poured over the paraffin and the genitalia then fastened in position by means of a *minuten nadeln*. It was only by this method that the genitalia could be securely fastened in position. Cotton, sand, and glass chips were unsatisfactory for this purpose. Light reflected up through the paraffin provided a satisfactory background. Glycerine invariably worked down under the paraffin and loosened it, and new study dishes had to be prepared every month.

For permanent preservation of the genitalia the following method was employed: a cork disc  $\frac{1}{16}$ " thick and 10 mm. in diameter, with a hole 4 mm. in diameter slightly off center, was attached to the insect pin bearing the specimen. A 7 mm. circular coverslip was then fastened to the

ventral surface of the disc by means of Canada balsam. If desired the coverslip could be fastened to the disc before the latter was attached to the pin. A thin layer of balsam was next placed in the resultant cavity, and the genitalia arranged in this layer. Previous to this arrangement, the genitalia had been immersed in absolute alcohol from one to five minutes. The disc was then set aside for 24-48 hours until the balsam hardened. This firmly fixed the genitalia in position so that when the remainder of the balsam was added the genitalia did not float about. The surface tension of the thin layer kept the genitalia in position until the hardening occurred. Genitalia placed directly in a thick layer of balsam would rarely stay in position even though the disc was kept horizontal. At the end of the hardening period the entire cavity was filled with balsam and another coverslip fitted over the dorsal surface of the disc. The mount was then gently heated to drive off any air bubbles, after which it was stored in a horizontal position to prevent the genitalia from slipping to one side of the disc. If the mount was tilted excessively, the genitalia would shift their position even though the balsam had been preliminarily hardened. After the balsam hardened entirely it was possible to tilt the disc in any direction, at least temporarily, without the genitalia moving. Occasionally frass from the sides of the hole would get into the balsam, but this difficulty was overcome by previously soaking the cork discs in waste alcohol.

This type of mount permits direct examination of the genitalia both dorsally and ventrally. If the genitalia have been slightly tilted so that they lie on their lateral surface, the hole in the disc is still wide enough to permit examination of both dorsal and ventral surfaces. This method of mounting was satisfactory for the genitalia of *Conotrachelus*. A somewhat similar type was used by Mitchell (1936) for the preservation of the genitalia of *Megachile* (Hymenoptera). These mounts allow sufficient observation for taxonomic comparisons, but if detailed study is necessary, soaking the disc in xylene will dissolve the balsam and permit the removal of the genitalia.

Several dry mounts of genitalia were made, but with slightly softened genitalia and with genitalia that possessed a narrow apical process this method led to distortion of the specimen. The small vial-glycerine technique likewise could have been employed, but the balsam-filled cell mounts are easier to observe and more attractive in appearance.

A discussion of the technique involved in the eversion of the endophallus of the male genitalia is given on page 32.

## B. MEASUREMENTS

In measuring the various areas of the insect body and the male genitalia, the following system was employed: the length of the insect



was calculated from the anterior margin of the eye to the apex of the elytra, while that of the beak was a straight line from the apex to the ventral angle of junction between the beak and the eye. The length of the prothorax was computed dorsally at the midline, while the width was taken at the broadest point dorsally. The basal area of the elytra up to and including the humeri was the criterion for the elytral width, while the length of the elytra was calculated from the basal margin to the apex at the line of junction of the wing covers. The length of the aedeagus was measured dorsally from the basal median point to the apical median point, while the width was calculated only at the base. If the lateral plates of the aedeagus narrowly extended beyond the major portion of the base, as in *naso* Lec. (Fig. 59), the width was taken at the place where the narrow extensions of these plates joined the major basal portion of the aedeagus. The aedeagal struts were measured from their tips to their junction with the aedeagus.

### C. STUDIES OF COLLECTIONS AND TYPES

In order to get representations of the *Conotrachelus* fauna in the states included in this study, loans were requested of the universities and scientific societies in those states. In addition, requests were also sent to museums and to private collectors outside the midwestern area. The institutions and individuals from whom loans were secured are listed below. Other collections studied but not secured in loans are given; these are marked by an asterisk.

- \*Blanchard Collection, Museum of Comparative Zoology, Cambridge, Massachusetts.
- \*Bowditch Collection, Museum of Comparative Zoology, Cambridge, Massachusetts.
- \*Casey, Greene, Soltau, and Wickham Collections, United States National Museum, Washington, D. C.
- \*Dietz Collection, Museum of Comparative Zoology, Cambridge, Massachusetts.
- \*Eddy Collection, Museum of Comparative Zoology, Cambridge, Massachusetts.
- \*Fall Collection, Museum of Comparative Zoology, Cambridge, Massachusetts.
- Field Museum of Natural History, Chicago, Illinois.
- Frost Collection, Framingham, Massachusetts.
- Hayes Collection, Urbana, Illinois.
- Illinois State Natural History Survey, Urbana, Illinois.
- Iowa Insect Survey Collection, Iowa Wesleyan College, Mt. Pleasant, Iowa.
- \*Leconte Collection, Museum of Comparative Zoology, Cambridge, Massachusetts.
- \*Liebeck Collection, Museum of Comparative Zoology, Cambridge, Massachusetts.
- Massachusetts State College, Amherst, Massachusetts.
- Nason Collection, Department of Entomology, University of Illinois, Urbana, Illinois.
- \*North Carolina State Department of Agriculture Collection, Raleigh, North Carolina.
- University of Kentucky, Lexington, Kentucky.
- University of Minnesota, St. Paul, Minnesota.
- University of Missouri, Columbia, Missouri.
- University of Wisconsin, Madison, Wisconsin.

To be certain of specific identities, the type specimens of Leconte, Walsh, and Fall, at the Museum of Comparative Zoology, Cambridge, Massachusetts, and those of Schaeffer and Casey at the United States National Museum, Washington, D. C., were examined. In some cases types were inaccessible, and in these instances careful checking of the descriptions and examination of specimens identified as these species by various coleopterous specialists were the criteria employed.

#### D. ORGANIZATION OF DISTRIBUTIONAL DATA

In the distributional data, all locality records are from specimens actually seen by the writer. No previous state records from catalogues or publications have been included because of the possibility that misidentifications may have occurred.

In the consideration of holotypes, allotypes, paratypes, lectotypes, etc., the present location of the specimen involved is indicated by the capital letters enclosed in parenthesis at the end of the statement. The key to these abbreviations is as follows:

- (MCZ).....Museum of Comparative Zoology, Cambridge, Massachusetts.
- (USNM) .....United States National Museum, Washington, D. C.
- (ISNHS).....Illinois State Natural History Survey, Urbana, Illinois.
- (WPH).....Private Collection of Professor W. P. Hayes, Department of Entomology, University of Illinois, Urbana, Illinois.
- (MSC).....Massachusetts State College, Amherst, Massachusetts.
- (PU).....Purdue University, Lafayette, Indiana.
- (IISC).....Iowa Insect Survey Collection, Iowa Wesleyan, Mt. Pleasant, Iowa.
- (CAF).....Private Collection of Mr. C. A. Frost, Framingham, Massachusetts.
- (UMo).....University of Missouri, Columbia, Missouri.
- (HFS).....Private Collection of H. F. Schoof, North Carolina State College, Raleigh, N. C.
- (UIDE).....University of Illinois, Department of Entomology, Urbana, Illinois.

### IV. THE MORPHOLOGICAL CHARACTERS OF TAXONOMIC IMPORTANCE

The following discussion of the important morphological characters used in the taxonomy of *Conotrachelus* is based only on the species included in this study. The discussion is divided into four sections: (A) the body regions and their appendages, (B) coloration and vestiture, (C) characters for sex determination, and (D) the male genitalia.

## A. THE BODY REGIONS AND THEIR APPENDAGES

In the head region the characteristics of the beak are of chief importance. The head capsule in the different species is similar, usually being densely punctured, with the punctures smaller than those of the thorax. The beak, on the other hand, shows variations not only in the different species but also in the sexes.

The most reliable specific character of the beak is its length and form, either of which varies greatly in many of the species. By means of the length and slenderness of the beak it is possible to distinguish the females of both *elegans* (Say) (Fig. 39) and *hayesi* n. sp. (Fig. 40) from the female of *aratus* (Germ.) (Fig. 41). In the female of *naso* Lec. the beak is extremely long, reaching the abdomen, and this character alone separates it from the female of *posticatus* Boh. where the beak only attains the mesocoxae. The curvature of the beak sometimes is more pronounced in one species than in another, as in *nenuphar* (Hbst.) and *hayesi* (Figs. 35 and 40). In some species, especially those of Group III, the curvature is slight until near the antennal insertion, where it is suddenly bent inwards.

Another beak characteristic of importance is the ratio of the distance between the lateral apical emargination of the beak and the anterior margin of the ball of the antennal scape to the distance between the dorsal and ventral surfaces of the beak at the position of the antennal insertion. (See Fig. 105.) This is especially evident in species whose beaks differ in stoutness, since this proportional character affords a method by which the terms stout and slender can be given a more concrete basis.

The sulci of the beak are of secondary importance in specific identification, being used more in sex differentiation. The beak usually has three lateral sulci on each side between the base and antennal insertion. These sulci have been called the upper sulcus, the median sulcus, and the lower sulcus, the latter being that sulcus nearest to the antenna. Occasionally the lower sulcus is divided into two as in *tuberosus* Lec. These sulci have been used in descriptions in the past, the usual reference being "strongly sulcate or striate," "deeply striate," or "feebly striate." These statements, however, are too inflexible, and many times fit only certain individuals of a species. Frequently the sulci are distinct in one specimen and feeble in another, they may vary in distinction on the different sides of the beak, or the basal half of a sulcus may be distinct, the apical half obscure. Consequently one must be cautious in diagnosing the type of the sulci; otherwise the characterization may lead to confusion. These sulci sometimes are not present as in *adpersus* Lec., and in this case their absence is an excellent diagnostic character. If the sulci are present, distinction between species based on the relative development of the sulci is not altogether reliable.



Other sculptural features of the beak such as punctation and carination are more significant for sex differentiation than for specific distinction. The prominence of a dorsal median carina is sometimes largely dependent on the development of the uppermost sulci.

The position of the antennal insertion on the beak is primarily a sex characteristic, but the relative length of the funicular segments of the antennae is sometimes of specific interest. In a majority of the species the first two segments are subequal in length and each is longer than any of the others. The apical segments generally tend to become successively globose, and the first, while subequal in length to the second, is frequently much stouter. The most notable exceptions to the above pattern are *adspersus* Lec. and *recessus* (Csy.) where the first funicular segment is approximately as long as the next two combined.

The characters of the prothoracic region are principally based on the sculpture of the dorsal and lateral areas. These areas show differences in punctation; carination, and tuberculation in the various species. The punctation in all cases is dense and varies from reticulate to cribrate. It is difficult to set up distinctions based on the size and form of the punctures, since many of the species have punctations which are quite similar; and while the differences are evident with the insects in juxtaposition, it is quite difficult to describe them so that the user of the key may identify a single specimen. The species *geminatus* Lec. and *cribricollis* (Say), however, differ so greatly in their punctation that they can easily be separated or identified by its use.

The prothorax is sometimes longitudinally carinate on its median, dorsal surface, and this character has been used much in the past for specific distinction. In some species such as *seniculus* Lec., *naso* Lec., *leucophaeatus* Fahr., and *posticatus* Boh., it is a stable characteristic, but in others like *affinis* Boh. it is unreliable. In *affinis* Boh., *nenuphar* (Hbst.), and *buchanani* n. sp. the carina may be distinct on the apical half in some individuals; in others it may be lacking. Until a long series of specimens is examined, the relative distinctness of a prothoracic carina cannot be considered a certainty.

Tubercles are also present on the prothorax, particularly in Group I. Usually there are two discal pairs, one transversely at the middle, the other between the median pair and the basal margin. The prominence of these protuberances, however, like the prothoracic carina, is subject to much variation. Consequently, it cannot be used for specific distinction. Nevertheless, one western species not considered in this study, *tuberculicollis* Schffr., has such large and prominent tubercles that they are valid specific characters.

The presence of a median furrow on the prothorax is one of the



characters used to separate Group III from Groups I and II. It may vary in prominence, but it is always evident.

The relative length and width of the prothorax is an aid in description, but not for specific identification. In all the species studied it was wider than long, but the ratio between the two dimensions was variable.

Ventrally, the prothorax is always provided with a groove for the reception of the beak. This character is of importance in subfamily and tribal classification.

The mesothorax has two structures of importance, the mesoscutellum and the mesosternum. The mesosternum has been used by Leconte (1876) and Blatchley and Leng (1916) in separating *geminatus* Lec. and *cribricollis* (Say) from *posticatus* Boh., the structure being considered prominent in the latter, and not prominent and sloping downwardly in the other two species. This characterization is ambiguous, however, since the mesosternum of *cribricollis* (Say) can be considered prominent and it definitely does not slope anteriorly as is true in *geminatus* Lec. The writer has used the same structure in the present classification, but has placed the emphasis on the basal angles.

The mesoscutellum is a new taxonomic character in *Conotrachelus* which was first noticed in working with *albicinctus* Lec. and *buchanani* n. sp. These two species, as will be noted in the key (p. 41), are separated by this character; the mesoscutellum in *albicinctus* Lec., when viewed from the lateral aspect, is abruptly declivent basally, while that of *buchanani* n. sp. slopes gradually toward the base (Figs. 29 and 30). The same character has also been used to distinguish *iowensis* n. sp. from *nenuphar* (Hbst.). Before this character is employed to differentiate other species, however, it should be checked in a number of specimens, since the shape of the mesoscutellum in some species is not always constant.

The metathorax is chiefly of importance in sex determination as explained on page 24.

The thoracic appendages are of much significance both as characters for sex determination and as specific indicators. With the elytra, the costate alternate intervals have been emphasized a great deal by Leconte (1876), Blatchley and Leng (1916), and Mutchler and Weiss (1925), and in several instances it appears that too much importance was placed on them. In those species where the costae of intervals 3 and 5 are interrupted to form abrupt elevations, as in *nenuphar* (Hbst.), *albicinctus* Lec., and others, the interruptions are distinct and constant in occurrence. In species, however, where those costal elevations are feeble, as in *elegans* (Say) and others, the interruptions occurring in the costa of interval 5 are feeble and extremely variable. For example: *elegans* (Say)

is described as having the costa of interval 3 twice interrupted and that of interval 5 "not interrupted posteriorly at the postmedian band," while *aratus* (Germ.) has the costa of interval 3 twice interrupted and that of interval 5 "not broken anteriorly." As these two species have been difficult to separate the obvious difference in the form of the costa of interval 5 has been logically seized upon as a specific character. Mutchler and Weiss (1925) incorporated this costal difference into their descriptive key of this genus. When various individuals of both of these species are examined, however, it is revealed that the costa of interval 5 in *elegans* (Say) is complete or once interrupted posteriorly, or occasionally feebly interrupted anteriorly, while that of *aratus* (Germ.) is usually twice interrupted, sometimes once anteriorly. Consequently, a distinction between the two species on the basis of the interruptions of the elytral costal of interval 5 is valueless. The writer has also found that the elytral costa of interval 5 in numerous other species of Group I varies in form to the same extent as it does in the previously mentioned species. Too much weight, therefore, should not be placed on the interruptions of the costa of interval 5 unless the character has been found constant in a long series of specimens. In five specimens of *hayesi* n. sp. the costa of interval 5 is only interrupted anteriorly, but the writer feels that in all probability future specimens will show variations.

The interruptions of the costa of interval 3 in contrast to those of the interval 5 are two in number and constant in occurrence in Group I, except in *falli* Blatch., *nivosus* Lec., and rarely *elegans* (Say). In Groups II-IV the intervals are sometimes non-costate, and when they are costate two strong interruptions of the costa of interval 3 occur only in *tuberosus* Lec. The elytral costae in these other groups are more stable in appearance than those of Group I.

Leconte (1876) stated that the elytral costae in *nemophar* (Hbst.) are much more abruptly interrupted and the posterior elevations more prominent than in either *juglandis* Lec. or *albicinctus* Lec. This study has showed that while this is true in some instances, the reverse also occurs and, consequently, the relative abruptness and prominence of costal elevations are not to be relied upon.

In concluding this discussion of the elytral costae, it may be said that they are of distinct specific importance, but thorough observation should be made for any variations that may occur, before setting up a standard type for a species. Likewise, it should be kept in mind when identifying a specimen that a disagreement with the costal interruptions specified in the description should not be overemphasized if the other characters are in full agreement.

The humeri, serial punctures, relative length and width, and outline of the elytra are of special value in some species (e.g., humeri in

*crataegi* Walsh), but in general they are of less importance than the costae.

The legs are of much taxonomic importance. The number of teeth on the apical ventral area of the femora has been frequently used in classification. There are either one or two teeth present, the distal tooth sometimes being more of a denticle. These teeth usually are excellent characters, but a few intermediary species occur between the one- and two-toothed groups and confusion sometimes occurs. In those cases it has been necessary to insert a second character to clarify the situation. Thus, in *tibialis* n. sp. the male usually has the proximal tooth obliterated, and on this basis should go into the one-toothed group. Other characters and habitus, however, as well as the fact that the female has two distinct femoral teeth, place the species in the two-toothed group. Consequently, a tibial character of the male has been inserted in the key to prevent misidentification.

The punctuation of the legs has been studied, but it does not offer much possibility for taxonomic purposes, since it is similar in the majority of the species. The form of the tibiae, however, is of importance in some species, as in the male of *tibialis* n. sp. where the protibiae exhibit a remarkable distal concavity (Fig. 31a) in contrast to the normal protibiae found in all other species of *Conotrachelus* (Fig. 31b). Likewise *anaglypticus* (Say) shows a distinct concavity at the distal end of the metatibiae in the male (Fig. 32a) usually not found in other species.

The most reliable leg character revealed by this study is the shape of the metauncus, or metatibial spine (Fig. 20). Before discussing the taxonomic value of this character, it is necessary to consider the morphology of the structure. The term uncus (pl. unci) is taken from Marshall (1932) who states that it is a stout, curved hook developed from the outer apical angle of the tibia. Another spine developed from the inner angle of the tibia is called the mucro (pl. mucrones). Usually each of these types of spine is distinct, but the uncus tends to shift inwards, so that in some cases it appears to rise from the inner angle and resembles a mucro. This shifting occurs in *Conotrachelus* as will be seen in Fig. 20 where both an uncus and a mucro are present. The mucro appears to be absent in the male in many cases, but it is present in the female, although often obscured by a tuft of setae. The uncus, on the other hand, is always evident in both sexes and is of value both specifically and for sex determination. The unci in the females are always single, never dentate, but in the male the metaunci are frequently dentate. Consequently, in many of the species the sexes can easily be determined by an examination of the metaunci. Therefore, in many cases where a distinguishing character between species has been lacking, it has been found possible to differentiate the species by considering the sexes



separately. Thus in *elegans* (Say) and *aratus* (Germ.) where a great deal of specific confusion has arisen in the past, it was found that the males of the two species are distinct, in that those of *elegans* (Say) have both meso- and metaunci dentate while in *aratus* (Germ.) only the metaunci are dentate (Figs. 25 and 26). The females of the two species are distinguished by differences in the length, stoutness, and form of their beaks (Figs. 39 and 41).

The shape of the dentate metauncus is sometimes of value in separating the males of species, as in the case of *affinis* Boh. and *hicoriae* n. sp. (Figs. 23 and 24). Species do not always show differences in the form of the denticle on the metauncus, and this is indicative of affinities (Figs. 26, 27, and 28). The shape of the metauncus may possibly vary in the same species (Fig. 25).

The chief taxonomic feature of the abdomen is its punctuation, which in this genus varies from sparse to dense and from fine to coarse. It is an excellent indicator in those cases where the differences in the density and distinctness of the punctuation are extreme, such as in the separation of *retentus* (Say), *affinis* Boh., and *hicoriae* n. sp. from *elegans* (Say), *aratus* (Germ.), *tibialis* n. sp., and others. Too much stress should not be placed on minor variations, however, since these may occur within the same species when enough specimens are examined. The chief difficulty with the use of abdominal punctuation, as well as that of other regions, is the use of relative terms which apparently must be employed to indicate the density and coarseness of the punctures. Terms such as "sparse" and "dense" are significant, but there is a wide range between these extremes which cannot be definitely characterized. In this paper, "dense punctuation" means one similar to that shown in Fig. 33, while Fig. 34 illustrates a "moderately dense" punctuation in the top half of the illustration and one slightly greater than moderate in the bottom half. The presence of a few widely scattered punctures is termed "sparsely punctured." The writer has attempted to limit the use of abdominal punctuation to the specific descriptions unless the differences have been exceptionally distinct.

The coarseness of punctures varies even on the same segment, as will be seen in Fig. 34, and the range between a fine and a coarse puncture is much greater than that which occurs between the extremes of density. A definite standard to refer to a "coarse," "fine," or "semi-coarse" puncture could not be devised because the scale would necessarily vary with the size of the species. The coarseness of punctures, consequently, has not been employed in the keys unless the distinction was obvious.

In the descriptions, both density and coarseness of punctures have been used. The number and type of punctures frequently vary on the different sterna, and such comparisons appear to be of distinct value in



descriptions. The fifth abdominal sternum\* frequently has a tubercle on both sides of the middle on the apical third, but the prominence of these tubercles is variable and the character is not reliable (see page 90).

#### B. COLOR AND VESTITURE

In the genus *Conotrachelus* as in many other groups, coloration is usually an unreliable character. Freshly emerged specimens naturally have a lighter color than those in which the pigment has been fully developed. This is particularly evident in those species of *Conotrachelus* that have been bred from nuts, such as *retentus* (Say), *affinis* Boh., and *hicoriae* n. sp. Specimens collected in nature are much darker and at first glance would appear to be different from reared specimens. In a few cases, however, color is of importance, such as in *nenuphar* (Hbst.) and *iowensis* n. sp. where intense blackish areas on the elytra are characteristic of the species. In most of the species, the described piceous color may vary from black to red. Consequently, complete agreement between the color pattern of the specimen and that given in the description is sometimes lacking.

The type, density, and color of the vestiture are all of taxonomic importance as may be seen in the keys. The vestiture is usually composed of elongate, recumbent setae varying in color from white to a rusty red. These setae may be replaced by true scales, as in *recessus* (Csy.), or they may resemble scales to such an extent that they are termed "scale-like setae," as in *adspersus* Lec. Occasionally the prothoracic punctures and the elytral intervals bear, in addition to the recumbent setae, prominent suberect and erect setae, as in *cribricollis* (Say) and *erinaceus* Lec. The variations that occur in the type of setae present are innumerable, but the above are the principal forms.

The relative densities of the setae or scales in the different species are of much importance when these relations can be expressed so they are clearly evident to the user of the key who has only one specimen on hand. Only in those cases where differences in the density of the setae or scales are extreme are such characters used in the keys, as in couplet 1 of the Group IV key. In many of the species the setae are scattered about with small condensations here and there, but in Group I the species usually have a definite, postmedian condensation which is of use taxonomically both by its distinctness and by the color of the setae composing it (couplets 4, 5, and 7 of the Group I key).

The color of the setae varies considerably in the same species, but

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\*The so-called fifth sternum is actually the seventh, since the first two abdominal sterna make up the posterior part of the metacoxal cavities and are not visible as sterna. The first visible abdominal sternum therefore is the true third. For taxonomic purposes and to avoid confusion, however, the true third sternum is considered the first ventral segment and the succeeding sterna are named accordingly.

there are several species in which the setal color is almost always constant in certain areas, such as in the postmedian bands of *buchanani* n. sp. and *albicinctus* Lec., and in the oblique, elytral bar of *anaglypticus* (Say).

The examples of the taxonomic value of the vestiture could be further enumerated, but a perusal of the keys and the descriptions, particularly the special characters, will indicate in a much better way its significance. The one disadvantage in its use is that specimens occasionally have their vestiture badly rubbed.

### C. CHARACTERS FOR SEX DETERMINATION

The sexes of all the species of *Conotrachelus* may be differentiated by the presence of an additional visible abdominal tergum in the male. Thus it will be seen in Fig. 10 (male) that the eighth tergum is distinctly evident, while in Fig. 12 (female) it is wholly concealed beneath the seventh tergum (shown by dash line). This sex character in *Conotrachelus* was discussed by Thomson (1932) for the sexes of *nenuphar* (Hbst.). The only possible disadvantage in the use of this character for the determination of the sexes is that it necessitates the disengagement of the elytra, but this is of little consequence when the sex of a specimen is an essential datum.

There are several other characters useful in sex determination, but none of these are common to the entire genus. Instead, they seem to occur at random among the different species. The first of these characters is the presence of dentate metaunci in the males of certain species. As the unci of all females are non-dentate, this character is a reliable one. It is found in some species of all the groups except Group III. In Group I dentate metaunci are more common than in the other groups, being found in *juglandis* Lec., *nenuphar* (Hbst.), *retentus* (Say), *affinis* Boh., *hicoriae* n. sp., *elegans* (Say), *hayesi* n. sp., *tibialis* n. sp., and *aratus* (Germ.). In Group II dentate metaunci occur in the males of *naso* Lec., *carinifer* Csy., and *posticatus* Boh., and possibly in *cribricollis* (Say). In Group IV *erinaceus* Lec. is the only species with this character. The dentate metauncus of *nenuphar* (Hbst.) was not noticed by Thomson (1932), although he did mention the extra large size of that uncus in comparison to the unci of the pro- and mesotibiae.

The second of the secondary sex characters is the presence in the males of metasternal grooves extending from the posterior border of the mesocoxae to the anterior rim of the metacoxae (Fig. 19). This character is confined to Group I, although not present in all of the species. *C. juglandis* Lec., *nenuphar* (Hbst.), *albicinctus* Lec., *retentus* (Say), *elegans* (Say), *aratus* (Germ.), and *buchanani* n. sp. possess these grooves, which are particularly distinct in the first three named species.

They are frequently feeble in *retentus* (Say), *elegans* (Say), and *buchananii* n. sp.

The third character is one commonly observed in Rhynchophora, in which the male has a shorter beak than the female. This is true in a number of species of *Conotrachelus*, but in many instances both sexes must be available before the difference can be seen. In *naso* Lec., *hayesi* n. sp., and *adspersus* Lec. the sexes may easily be distinguished without such recourse, since the difference in the length of the beak in the two sexes is pronounced (Figs. 37 and 40).

Another use of the beak in sex differentiation is found in its sculpture, which is generally more distinct in the male than in the female. In the males the lateral sulci extend from the base to near the antennal insertion, the dorsal carina is acute, and the punctuation of the dorsal surface distad of the antennal insertion is dense, while in the female the grooves are less distinct apically, the carina is sometimes scarcely evident, and the distal punctuation is sparse and fine. The sculpture is a relative character, and only occasionally can the sex be definitely identified by it. The best example of such an instance is found in *juglandis* Lec.

The position of the antennal insertion on the beak is also of importance in sex determination. The female invariably has the antennae inserted nearer the middle of the beak than the male, but the difference in most instances is so slight that it is only useful in a comparison of the sexes. Frequently, however, the difference is so great that the character can be applied to the one sex in the absence of the other; for example, in *recessus* (Csy.) the antennae are inserted at the middle of the beak in the female and at the distal third in the male.

The foregoing characters are those which have been found to occur in several species. In addition, there are several sex differentiation characters which are limited to one or two species, such as the costate first and second elytral intervals of the males of *naso* Lec. and *posticatus* Boh., the apical concavity of the male protibiae of *tibialis* n. sp. (Fig. 31a), and the distal emargination of the male metatibiae in *anaglypticus* (Say) (Fig. 32a).

#### D. THE MALE GENITALIA

1. *Morphology*: The male genitalia of Coleoptera were treated in a general way by Sharp and Muir (1912), who made a comparative study of various species in this order. In addition, Sharp (1918) published a preliminary note on the male genitalia of the Rhynchophora in which he discussed the various genital structures found in this group. Verhoeff (1896), Sharp (1920), Hopkins (1921), Kaston (1936), and others have investigated the genital morphology of either a single species or a genus. The only morphological study on the male genitalia of



*Conotrachelus* was that made by Sharp (1920) on *C. brevisetis* Champ., a tropical species.

In almost all the investigations since 1912 the terminology of Sharp and Muir (1912) has been followed. Kaston (1936) used it, and in addition discussed and tabulated the terms employed by other workers. Included in Kaston's work is the nomenclature of Snodgrass (1935), which is the terminology employed in this paper, except in those cases where structures are involved which Snodgrass did not consider. Snodgrass' terms are followed because they are applicable to the various orders of insects, and the author feels that a nomenclature which can be used in this manner is far superior to one which is limited to a single order. In those cases where structures are involved which Snodgrass did not consider, the terminologies of Sharp and Muir (1912) and Sharp (1918) have been followed. Occasionally new terms have had to be devised.

The male genitalia are contained within an invagination of the body wall distad of the eighth abdominal segment. The term phallus is used collectively, to designate all the parts of the external male genitalia. The principal structures which make up the phallus (Figs. 1, 3, and 8) are the first and second connecting membranes, spiculum gastrale, phallobase, aedeagus, endophallus, and appendages of these parts.

In the following discussion each of these structures except the connecting membranes will be considered individually. Unless otherwise stated, all data refer to *C. nenuphar* (Hbst.).

The first connecting membrane extends from the body wall to the phallobase (Figs. 8 and 9, dash line), while the second leads from the phallobase to the aedeagus (Figs. 8 and 9, dotted line). Sharp and Muir (1912) named these parts reversely, but Sharp later (1918) designated them as above. The first connecting membrane fits tightly over the strongly sclerotized aedeagus and frequently is difficult to discern. Dorsally the alimentary canal enters this membrane, while ventrally the conspicuous spiculum gastrale arises from it. The second connecting membrane is doubled upon itself when the aedeagus is in repose and may be triplicated proximad of the aedeagus depending on the position of the phallobase. This membrane in repose is seldom straight as shown in Fig. 8, but more often is creased or wrinkled. In copulation it straightens out and allows the aedeagus to be protruded. The second connecting membrane is usually closely applied to aedeagal struts.

The spiculum gastrale (Figs. 1 and 3) is a conspicuous, curved, sclerotized rod found on the ventral surface of the aedeagus arising from the first connecting membrane. Apically it is strongly curved, while basally it divides into two forks between which a heavy membrane extends to form a broad plate. From the inner angle of the forked base a



slender internal groove proceeds apically, where it evanesces. The spiculum gastrale extends beyond the basal portion of the aedeagus and varies in width from that shown in Fig. 3 to a slender elongate rod. The majority of the spiculi observed were of the widened type.

The spiculum gastrale is attached by muscles ventrally to the sclerotized triangular portions of the eighth sternum, and to the lateral walls of the eighth tergum (Fig. 3, muscles C). These muscles serve to hold the spiculum gastrale in place in the abdominal cavity during copulation. Two other sets of muscles attach to the spiculum gastrale, one at its widened apex (Figs. 3 and 8, muscles A) and the other at that edge of the base which is proximad of the phallobase (Fig. 3, muscles B). These two sets of muscles are apparently the retractors and the protractors of the phallobase, as will be seen by comparing Figs. 8 and 9. The retractor group, from the apex of the spiculum gastrale to the phallobase, appears to be a powerful set of muscles and possibly aids in the retraction of the aedeagus. The protractor set is composed of a much less dense mass of muscles which in some instances is difficult to see.

The phallobase (Fig. 1), (tegmen of Sharp and Muir, 1912), consists of a sclerotized ring bearing two dorsal lobes (epimeres). According to Sharp (1918) the phallobase may also be an incomplete ring in some Rhynchophora, but in *Conotrachelus* the ring is always complete. The phallobase in Rhynchophora usually is provided ventrally with a single basally directed strut, but in *Conotrachelus* the median ventral region never develops basally to the extent that it might be termed a strut (Fig. 3). Various forms of this development are shown in Figs. 13 to 18. The epimeres are difficult to discern unless the phallobase is pulled up over the aedeagal struts (Fig. 9). Their shape is quite similar in the species of Group I to that shown in Fig. 1, but in Groups II, III, and IV, they may be much more elongate. The phallobase, in repose, is usually situated at the base of the aedeagus, but in *seniculus* Lec. it surrounds the aedeagus one-third of the distance distad of the base. As previously mentioned, the phallobase is acted upon by two sets of muscles (Figs. 3, 8, and 9).

The most conspicuous structure of the male genitalia is the strongly sclerotized aedeagus. Sharp and Muir term this structure the median lobe and consider the aedeagus as consisting of both the tegmen (phallobase) and the median lobe (Figs. 1, 2, and 8). The aedeagus is essentially a hollow tube inside of which the endophallus is contained. It varies greatly in form in the different species and is the most important structure for specific classification. Dorsally it consists of a pair of heavy sclerotized lateral plates and a median area. This median area when slightly sclerotized as in *nenuphar* (Hbst.) (Fig. 1) is termed the dorsal plate; when entirely membranous as in *naso* Lec. (Fig. 59) the dorsal

membrane. When a dorsal plate is present it is separated apically from the lateral plates by membranous areas (Figs. 1 and 52) except in *seniculus* Lec. (Fig. 56). These membranous areas, of course, are absent in those species having a dorsal membrane (Fig. 58). In either case the lateral plates, which also extend to the ventral surface, unite apically to form either a prominent process (Figs. 53, 66, 67, and 68), a feeble process (Figs. 42 and 50), or sometimes no process at all (Figs. 56 and 63). The dorsal areas of the lateral plates in Group I, particularly beyond the extent of the dorsal plate, become depressed so that subapically the lateral plates are solid dorsoventrally instead of the dorsal and ventral surfaces being widely separated. This may be seen by noting the gradual subapical convergence of the dorsal and ventral surfaces in Figs. 74, 78, and 79. Basally the lateral plates may unite (Figs. 52, 59, 62, and 64) or be separated by a dorsal membrane (Figs. 66 and 68) or a dorsal plate (Fig. 45). Frequently, as in Figs. 42, 46, 47, and 51, there is a faint internal indication of the extension of the dorsal plate to the base. The extent and shape of the dorsal plate and dorsal membrane are quite variable as will be seen by a comparison of Figs. 42 to 68. Neither of these structures extends to the apical junction of the lateral plates; instead each terminates a short distance before the junction.

Ventrally, the aedeagus is bounded by the same lateral plates, and the median area here also may be either lightly sclerotized (ventral plate) or membranous (ventral membrane) or both (Fig. 2). Usually the basal portion of the aedeagus is lightly sclerotized and the apical portion membranous, although the relative proportion of each type is variable (compare Figs. 84 and 85). In a lateral view the ventral membrane is usually the only portion visible.

On their ventral surfaces the lateral plates are extended basally in the form of two elongated projections (Fig. 2) which are termed aedeagal struts (median struts of Sharp, 1918, p. 217). These struts are always present in Rhynchophora and assume a variety of shapes and sizes. The same is true in the genus *Conotrachelus*, although in closely related species they differ but little. In *seniculus* Lec. the aedeagal struts are small, the aedeagus being eight and one-half times their length, while in *crataegi* Walsh the struts are three-fourths as long or may even equal the aedeagus in length. The apices of the struts also vary in form. The ventral plate likewise projects basally to give rise to an angulate structure between the aedeagal struts. This median projection is usually difficult to discern, since the second connecting membrane encircles it. Usually the projection extends beyond the basal border of the aedeagus, but occasionally it may be parallel to it as in *seniculus* Lec.

As previously mentioned, the dorsal plate or membrane does not extend to the apical junction of the lateral lobes, so that there remains

distad of it an area in which the ventral membrane is visible from above. Since this area is distad of the phallotreme (Fig. 5), it has been termed the prephallotremic area (Figs. 1 and 42).

Summarizing, it may be said that the aedeagus is a hollow structure consisting of two heavily sclerotized lateral plates which extend both dorsally and ventrally and are separated dorsally and ventrally by median, membranous, or lightly sclerotized areas.

The endophallus (Figs. 4 and 11), (internal sac of Sharp and Muir, 1912; praeputial sac of Verhoeff, 1896), is that structure of the male genitalia which effects the transfer of sperm from the male to the female. It bears the opening of the ejaculatory duct, the gonopore (Fig. 7), (functional orifice of Sharp and Muir, 1912), and is instrumental in bringing about a close connection between this orifice and the mouth of the spermathecal duct in the female. The endophallus is chiefly membranous, but also contains sclerotized plates as well as numerous spines. When not in use in copulation, it is usually inverted and contained within the aedeagus (Fig. 4) with the sclerotized, lateral plates of the aedeagus on the sides, the dorsal plate above, and the ventral plate and membrane below. In such a position the endophallus occupies the greater portion of the aedeagal cavity. Usually it remains in this position until the aedeagus is inserted into the female during copulation, but in some species of Lucanidae, Heteroceridae, Lycidae, and Scarabaeidae (Sharp and Muir, 1912, p. 607) the endophallus is permanently everted and is never contained within the aedeagus. Thus it appears that the principal functions of the aedeagus are to place the endophallus in a position where it can effect a close connection between the sperm duct of the male and the spermathecal duct of the female, and to protect it while copulatory attempts are being made.

In *C. nenuphar* (Hbst.) the endophallus (Figs. 7 and 11) consists of two large, sclerotized, roughly diamond-shaped plates and a membranous portion which makes up its greater area. The membranous area is covered with numerous spines and is trilobed when fully everted. The lateral, membranous lobes are broad basally and narrowed apically, the spines becoming larger as the lobes narrow. When everted the lateral lobes push out to the sides and curve basally. In this position they doubtlessly function as a holding mechanism in copulation. The middle lobe is directed apically and consists of a broad, dorsal lobe and an elongate, ventral lobe. The dorsal lobe is separated from the lateral lobes by minutely spined or spineless strips, while the ventral lobe is ventrad of the lateral lobes. In repose the ventral lobe hangs beneath and to the side of the main portion of the endophallus (Figs. 4 and 5). In this position, it may be seen to contain many internal spines, all of which are directed apically. The ventral lobe of the endophallus is extremely diffi-



cult to evert even in fresh specimens, and only after repeated efforts is extension successful. The dorsal lobe, in comparison, everts readily and may be fully extended even though the ventral lobe is still within the aedeagal cavity. Because of this arrangement of the two lobes, and the fact that when forced out of the aedeagal cavity by vigorous pulling with a needle, the ventral lobe hung limply beneath the dorsal lobe, it was at first concluded that the ventral lobe was incapable of protrusion. The presence of a strongly spinose, internal wall in a passive structure, however, appeared to be a paradox. Up to this time, attempts to evert the ventral lobe had been on the assumption that the lobe was a tubular structure which would evert by a reversal of the internal and external walls such as occurs in the dorsal lobe (compare Figs. 5 and 11). The ventral lobe, though tubular in outline in repose, does not extend in this manner. The tubular outline of the lobe is brought about by a pushing in of the dorsal wall so that a double-layered tube is formed (Fig. 6a). In this way the spines which are present on the lateral edges at the apical tip of the ventral lobe (Fig. 7) approach each other as shown in Fig. 6a. In repose, the tube thus formed has the spines internally and pointing apically. When eversion takes place, the inner spinose layer is thrown upward and laterally (Figs. 6b and 7) and the spines are directed basally. When so extended, the ventral lobe appears to be an accessory holding mechanism for use in copulation. The location of the gonopore between the two sclerotized plates (Fig. 7) instead of at the tip of the ventral lobe would further indicate this type of function for the ventral lobe. The lobe has muscles attached to its apical end which serve for its retraction and possibly aid in the inversion of the entire endophallus.

Although mechanical eversion of the ventral lobe was possible in fresh specimens, the genitalia of one male killed when in copulation showed the ventral lobe within the aedeagal cavity although the remainder of the endophallus was fully everted. This, plus the extreme difficulty of everting the ventral lobe, leads one to the conclusion that the lobe possibly does not extend during copulation but has a more passive role.

When the endophallus is everted the two sclerotized plates lie proximad and dorsad of the membranous portion (Figs. 7 and 11). These plates form the transfer apparatus (Sharp, 1918, p. 218), and are of great importance since the ejaculatory duct has its opening between them. Both plates are roughly diamond-shaped, and each contains a hole, the purpose of which is not apparent. Attached to the plates are muscles used to retract the endophallus, while lying between the plates is the small, obscure opening of the ejaculatory duct, or gonopore. Dorsad and proximad of the transfer apparatus is a small, slightly sclerotized plate having teeth along its apical border (Figs. 7 and 11, hinge plate). This



structure is attached to the dorsal plate of the aedeagus and serves as a hinge upon which the endophallus is everted. When the endophallus is in repose the sub-basal edge of this hinge plate projects beyond the apex of the dorsal plate of the aedeagus (Figs. 4 and 5). The opening beneath the hinge plate formed by the inversion of the endophallus is termed the phallotreme (Fig. 5).

The natural eversion of the endophallus is effected by blood pressure (Sharp and Muir, 1918, pp. 610-11). This phase of the eversion was not studied by the writer, the method of eversion being considered primarily. The points mentioned in the following discussion were determined by artificial eversion of the endophallus with a needle, but the writer feels that the normal method would be the same regardless of the difference in the agent.

In repose, the endophallus is as shown in Figs. 4 and 5. The dorsal plate of the aedeagus is level with the lateral plates (Fig. 9), the dorsal lobe is inverted with its spines on the inner wall, the lateral lobes approach each other apically, diverging basally where they pass beneath the transfer apparatus. The latter is most evident, being in the approximate central area of the entire sac and just beneath the dorsal plate. The hinge plate has its spines pointing basally and its basal border protruding distad of the apical edge of the dorsal plate. The ventral lobe has its apical end projecting beyond the basal border of the aedeagus beneath the second connecting membrane (Fig. 4, connecting membrane not shown), and the ejaculatory duct may be seen rising from near the ventral membrane of the aedeagus and passing dorsally over the sac to its insertion between the plates of the transfer apparatus (Fig. 5). The courses that these various structures follow during the eversion of the endophallus are shown diagrammatically in Fig. 5 and are also evident by comparison of Figs. 4 and 7. The lateral lobes slowly push out toward the sides, curving basally, while the dorsal lobe area slowly everts apically. At the same time, the hinge plate and the plates of the transfer apparatus swing ventrally so that their basal point shown in Fig. 4 becomes their apical point in Fig. 7. The reversal of these plates requires an increase in the size of the phallotreme (median orifice of Sharp and Muir, 1912, p. 482), and this is accomplished by the elevation of the dorsal plate of the aedeagus (Fig. 11). Extension of the ventral lobe, if occurring, takes place after the lateral and dorsal lobes and transfer apparatus have been fully everted. The complete eversion finds the structures as shown in Figs. 7 and 11, the endophallus presenting an approximately forty-five degree slope.

Sharp (1920, Plate IV) found the endophallus in *Conotrachelus brevisetis* Champ. (a South and Central American species) when everted

to consist of a large ventral bladder-like sac with a distinct small lobe containing the transfer apparatus on the dorsal surface of its base. Sharp considered this position of the transfer apparatus as remarkable, since these plates are usually more closely connected with the wall of the main sac and placed more or less at its apex. In *C. nenuphar* (Hbst.) a dorsobasal position of the transfer apparatus is obtained, but the apparatus is not set off in a small lobe from the remainder of the sac. Sharp also stated that the extreme hardness and complex shape of the transfer apparatus in *C. brevisetis* Champ. was unusual in the Curculionidae. The writer, although not making a detailed study of the endophallus in other species of *Conotrachelus*, has noted that a complex, hardened, transfer apparatus does occur in a number of species, such as *seniculus* Lec., *cribricollis* (Say), *leucophaeatus* Fahr., *naso* Lec., *posticatus* Boh., *fissunguis* Lec., *anaglypticus* (Say), *erinaceus* Lec., *crataegi* Walsh, *geminatus* Lec., *tuberosus* Lec., and *adspersus* Lec. In these species, excepting *seniculus* Lec., the transfer apparatus consists of one to three pairs of sclerotized bars. These bars assume a variety of shapes, some being J-shaped, others elongate and sinuate, and still others semicircular. In some instances the bars protrude into the prephallotremic area as is shown in Figs. 59, 60, and 68.

The technique of artificial eversion of the endophallus is simple to explain but difficult to apply. After removal, the genitalia are held in place by a small needle pushed through the phallobase. Since the endophallus apparently does not attach below to the ventral membrane but is suspended from the lateral plates, a fine needle with a slightly hooked end is then inserted between the ventral membrane of the aedeagus and the endophallus with the hook turned sidewise. When the needle passes the basal end of the endophallus, it is twisted so that the hook points dorsally. It is then slowly withdrawn, and if a hold on the endophallus has been obtained, eversion is gradually accomplished. Usually, several attempts have to be made before success is attained. In this study fresh specimens were used, and the extension of the endophallus was not so difficult as it would have been in preserved specimens.

Sharp and Muir (1912, pp. 483-484) and Sharp (1918, pp. 220-221) described this method of eversion and their study was made on a wide range of Coleoptera with dried specimens up to sixty years of age. When eversion is complete, these workers inject the endophallus with water to restore it to its natural form. The smaller the specimen, the more exacting is the eversion, and in some cases it appears impossible. Specimens that have been killed and preserved in alcohol are not suitable for the extension of the endophallus (Sharp, 1918, p. 221). Specimens which are killed in alcohol and immediately examined, however, give suitable re-

sults. In fresh specimens of other Coleoptera, such as Staphylinidae, the endophallus may be everted by gently pressing upon the median lobe (Sharp and Muir, 1918, p. 483).

2. *Taxonomic Value*: The male genitalia are of distinct taxonomic importance in the genus *Conotrachelus*. Barber (1919, 1923), however, has been the only worker to use these structures in the taxonomy of this group. He separated males of *serpentinus* (Klug), *aguacatae* Barber, and *perseae* Barber by means of aedeagal differences. As the various structures of the male genitalia are not of equal significance, a brief discussion of their relative taxonomic values is given here.

The two connecting membranes are similar in all the species studied, and the spiculum gastrale appears to be affected by the age of the individual, so that these three structures are of little taxonomic value.

The phallobase, on the other hand, shows some evidence of being useful, perhaps in the separation of groups of species, since it was noted that the epimeres usually are distinctly longer in Groups II, III, and IV than in Group I. There are also differences in the configuration of the phallobase, but in many instances closely related species have phallobases of similar form. In addition, the sclerotization of the phallobase varies within some species, and sometimes its limits are difficult to discern, so that it is not useful in classification. Originally the writer had some hope that the median, ventral area might be of use, since this area is wider than the remainder of the phallobase and is produced basally in various shapes. It was found, however, that this median area varied greatly in form within some species (Figs. 14, 16, and 17), and frequently different species had similarly shaped, basal productions (Figs. 13 and 16).

The endophallus is of importance in the definition of groups of species and may be of specific value. In Group I, with the exception of *seniculus* Lec. and *nivosus* Lec., all the species have the same type of endophallus as that shown in *nenuphar* (Hbst.) (Figs. 7 and 11), although in some species it may be slightly modified. Essentially, however, it is the same even though the aedeagi of the various species may differ greatly in form (Figs. 42 to 54). In addition to these aedeagal differences, the external morphological characters of the species are also variable, as will be noted by a brief glance at the descriptions of some of the species in Group I. From this, one may infer that the endophallus is a true index to group relationship even when the other morphological characters of the species are divergent. This relationship is mainly evident by examination of the transfer apparatus which is the prominent sclerotized part of the endophallus (Fig. 7). Sharp (1920, p. 75) states: "The shape and nature of the transfer apparatus differs greatly in the various forms of Rhynchophora, so that it will be difficult to generalize it for the purpose of



definition of the great groups, but it will be found very important in the case of definition of genera and tribes."

The endophallus may possibly be used as a specific character in those species which have a dorsal membrane instead of a dorsal plate (Figs. 58 to 62 and 64 to 68) and possess several distinct sclerotized bars in the transfer apparatus. When a dorsal membrane is present, the transfer apparatus is visible from above, and the size and shape of prominent sclerotized rods can be observed. Some of the less distinct bars, however, are obscure, so that the true relationship of all the structures in the transfer apparatus cannot be determined unless the endophallus is everted. In the descriptions of the male genitalia of *cribricollis* (Say), *geminatus* Lec., and other species of Groups II, III, and IV, mention is made of the shape and position of the prominent bars of the transfer apparatus. The sclerotized bars, when beneath the dorsal membrane, are not shown in the illustrations, since, without being everted, their relationships could not be accurately determined. When the sclerotized bars protrude into the prephallotremic area, they are included in the illustrations (Figs. 59 and 60). A specific difference in the sclerotized bars of these two species is clearly perceptible. The greatest handicap to the use of the endophallus is the difficulty of its eversion, even in fresh specimens. If this handicap is ever overcome, a distinct advance in the phylogeny and taxonomy of this genus will be possible.

The genital structure of the most taxonomic significance is the heavily sclerotized aedeagus. The aedeagus shows distinct variations among the different species and yet is constant within a species. There are minor variations in size and shape within a species, as will be seen by comparison of Figs. 1, 4, and 7, but these variations are too slight to prevent the use of the aedeagus in specific identification. A series of eleven specimens of *seniculus* Lec. from the same locality were examined to determine the extent of variation in such a group, and specimens from other localities were also examined. Some slight variations in the dorsal outline were found. In some instances an evident indentation was present at the apical third instead of only a feeble indication as shown in Fig. 56. The lateral plates and dorsal plate also varied slightly in their relative proportions. In no case, however, were the variations such that the aedeagus could be mistaken for that of another species. Numerous specimens of *nenuphar* (Hbst.) were also examined, and a similar conclusion was drawn.

The specific variations of the aedeagus are illustrated in Figs. 42 to 95. Before discussing the relative value of the parts of the aedeagus, it is necessary to define some of the terms not yet discussed. In a dorsal view, the outer limit of the lateral plate, on each side, is termed the outer curvature (Fig. 42). The inner limit is termed the inner curvature



(Fig. 42). From the lateral aspect the upper boundary of the lateral plate is designated the dorsal curvature; the lower boundary, the ventral curvature (Fig. 84).

In a dorsal view of the aedeagus the outline of the structure is of utmost importance. For example, its shape in *aratus* (Fig. 53) is distinctly different from that in *elegans* (Fig. 51). All other species also differ in this respect. The inner curvature is of less importance, but varies in the different species, as will be seen by a comparison of Figs. 61, 64, and 67. Sometimes this curvature is rather indistinct basally, as is shown in Figs. 60 and 65 (irregular lines).

The dorsal plate varies in shape in the different species, but it also may vary quite extensively in the same species. Unless the dorsal plate is exceptionally distinctive, as in *aratus* (Germ.) (Fig. 53) and in *crataegi* Walsh (Fig. 57), it is not a reliable character. The presence of the dorsal plate links together all the species of Group I in contrast to those of Groups II, III, and IV, where a dorsal membrane replaces the plate (except in *crataegi* Walsh). Another distinctive group feature is that the apex of the dorsal plate is usually transverse (Figs. 42 to 54) while that of the dorsal membrane is either V-shaped or semicircular apically (Figs. 62 and 68). Exceptions to these generalizations are found in *crataegi* Walsh (Fig. 57) which has a dorsal plate that is V-shaped apically, and in *seniculus* Lec. and *hayesi* n. sp. which have the dorsal plate incurved apically.

In *seniculus* Lec. the dorsal median area is lightly sclerotized, but no membranous areas are present between the dorsal plate and the lateral plates as in the other species (except *nivosus* Lec.) of Group I. Another aberration in Group I in regard to the structure of the dorsal median area is found in *nivosus* Lec. where the dorsal plate is obliterated except for a minute triangular piece basally. It may seem from this discussion that there are so many exceptions that no definite relationships are present. If it be remembered, however, that numerous southwestern and Gulf Coast species are not considered in this study, then these discrepancies in the data are explained in part. The writer believes that with a larger series of species the presence of a dorsal plate or membrane and its various intermediate and aberrant shapes may be successfully explained phylogenetically.

The dorsal plate usually is difficult to see in glycerine or alcohol mounts unless the endophallus is everted or unless it is heavily sclerotized, which is rarely the case. If the aedeagus is allowed to dry temporarily, the dorsal plate becomes distinct. When in a liquid mount, considerable manipulation is necessary before its shape can be observed.

The apical process is variable in its development in various species (Figs. 42, 43, 47, 53, 54, 60, and 62). When a process is present, it is

easy to distinguish between the species, such as in Group I, where *nenuphar* (Hbst.) by the possession of a distinct apical process is readily distinguished from its close relatives, *buchanani* n. sp., *iowensis* n. sp., *juglandis* Lec., and *albicinctus* Lec. (Figs. 42 to 46). The shape of the process is also of value, as will be noted with the species of Group III (Figs. 66, 67, and 68). Since the apex of the aedeagus is curved ventrally, it is not visible in the dorsal view. Consequently, a separate sketch of the apex in the various species has been made to show its form and prolongation (Figs. 42 to 68).

The aedeagal struts do not vary significantly in closely related groups and are not included in the illustrations.

The lateral view of the aedeagus (Figs. 69 to 95) is chiefly important for the observation of the dorsal and ventral curvatures. Usually it is less important than the dorsal view. The lateral plates, dorsal plate or membrane, and the ventral plate or membrane are visible in a lateral view.

The dorsal plate or membrane varies in its prominence depending on whether or not the endophallus is slightly everted. Sometimes it is quite prominent (Figs. 74 to 77), at other times scarcely evident (Figs. 72 and 73). The ventral plate is visible in only a few species (Figs. 84, 85, 86, and 87), but the ventral membrane is usually evident. The dorsal and ventral plates or membranes, however, are usually not of taxonomic importance in a lateral view, since they vary greatly, depending on the position of the aedeagus and the extent to which the endophallus is inverted. These two structures are included in the drawings chiefly to orient the lateral position of the aedeagus so that comparisons with the illustrations may be made from specimens in the same position. The dorsal and ventral curvatures vary in the different species and are of distinct importance. Comparison of Figs. 86, 87, 91, and 92, as well as the other lateral figures, will illustrate this point.

An interesting point concerning the aedeagi is that their length may not be in proportion to that of the adults. Thus the aedeagus of *hayesi* n. sp. (Fig. 52) is distinctly longer than that of *juglandis* Lec. (Fig. 42), although the adults of the *hayesi* n. sp. range from 4.7 to 5.1 mm., and *juglandis* Lec. from 5.9 to 7.1 mm. The same is true of *recessus* (Csy.) (Fig. 63) and *tuberosus* Lec. (Fig. 66), although the adults of both have the same range in length.

It appears from this study that excepting those morphological characters on which Groups I to IV are based, the genitalia (aedeagi) are truer indicators of specific relationships than the external morphological characters. Thus, in Group I the aedeagus of *falli* Blatch. clearly shows that it belongs in the group with *nenuphar* (Hbst.) and *elegans* (Say), even though its elytral and prothoracic sculpture is greatly different from that of these species. In Group III, *tuberosus* Lec. has the elytral costae

similar to those of *nemuphar* (Hbst.), yet its aedeagus (Fig. 66) clearly shows that it is related to *anaglypticus* (Say) and *leucophaeatus* Fahr. (Figs. 67 and 68). The close affinity of *fissunguis* Lec. and *erinaceus* Lec. is also evidenced by similarities in their aedeagi (Figs. 64 and 65), even though externally they are very distinct. The aedeagi in these instances indicate that the basic characters on which the groups are erected are valid, and do not fluctuate as do other previously mentioned "superficial" characters.

## V. NOMENCLATURE

The principal nomenclatural question in this genus involves the authorship and the position in the Curculionidae of the generic name *Conotrachelus*. Schönherr (1837 and 1845), Agassiz (1842-46), Lacordaire (1866), Provancher (1877), and Scudder (1882) credit Latreille (1835 or 1837) with the name *Conotrachelus*, while Melshheimer (1853), Gemminger and Harold (1871), Crotch (1873), Leconte and Horn (1876), Austin (1880), Champion (1904), Blatchley and Leng (1916), Leng (1920), Sherborn (1925), Schulze *et al* (1929), Hustache (1936), and Neave (1939) cite Schönherr (1837) as the author of the name. Dejean (1835, p. 296, and 1837, p. 321), who first published the name *Conotrachelus*, appended Latreille's name to it, and this has led some authors to credit Latreille with the generic name. Latreille, however, did not publish anything concerning the genus *Conotrachelus*, and consequently cannot be considered as its author. Schulze *et al* (1929) and Neave (1939) list *Conotrachelus* Dejean as a *nomen nudum*, but as Dejean first published the name and listed seventy-one species (i.e., names) under it, he may be considered as its author if any of the included specific names are valid. Of the seventy-one species listed by Dejean, four are considered valid by the writer. Two species, *concentricus* (Oliver) (1807) and *irroratus* (Fabricius) (1801), have definite bibliographic citations. The status of the other specific names, *diaconitus* Germar and *serpentinus* Germar, however, may be considered questionable by some in light of the strictest interpretation of the International Rules of Nomenclature. The facts concerning these names are as follows: Dejean (1835 and 1837) and Boheman (in Schönherr, 1837) both credited *Conotrachelus diaconitus* and *C. serpentinus* to Germar, but Germar did not describe either of them. Boheman included under his diagnosis of each of these species (pp. 397 and 402) this synonymy:

Conot. id. Dejean Cat. Col. ed. 2. p. 297, ed. 3. p. 321.

Balaninus id. Dom. Germ. in Litteris, teste Dom. Schuppel.

The first citation in this synonymy refers to Dejean's placements of 1835 and 1837, while the second apparently has reference to Boheman's



knowledge, or at least his belief, that the two species known to contemporary workers as *Balaninus diaconitus* Germar and *B. serpentinus* Germar were the same as the two placed in *Conotrachelus*, under the same two specific names, by both Dejean and Boheman. Klug (1829) briefly described *Balaninus diaconitus* and *B. serpentinus* and listed Germar (in lit.) as the author of both names. Klug's placement of Germar as the author of these names evidently was done only in deference to Germar, since the latter never published anything in connection with the two species. Consequently, Klug, being the first to publish the two names in connection with descriptive statements, must be considered as their author.

The question of the validity of these two names in the Dejean Catalogue depends on the interpretation of the previously mentioned data. If it can be inferred that Dejean (1835) had reference to *Balaninus diaconitus* (Klug) and *B. serpentinus* (Klug) when he included under the new genus *Conotrachelus* the specific names *diaconitus* Germ. and *serpentinus* Germ., then these two names can be considered valid in the Dejean Catalogue. The writer, basing his conclusion on three evidences, believes that such an inference can be made.

First, it would appear from Boheman's (1837) synonymy that Klug's (1829) species, *Balaninus diaconitus* Germ. (in lit.) and *B. serpentinus* Germ. (in lit.), Dejean's (1835) *Conotrachelus diaconitus* Germ. and *C. serpentinus* Germ., and Boheman's (1837) *C. diaconitus* Germ. and *C. serpentinus* Germ. are the same pair of species. Dejean and Boheman, as well as Klug, accepted Germar as the author of these species even though by present-day technical standards Klug himself was the author; similarly, as has been previously shown, Dejean and others accepted Latreille as the author of *Conotrachelus*.

The second evidence is found in the fact that in the Dejean Catalogue the two specific names are in the same consecutive order as they are in Klug's paper. This possibly is a coincidence, but it may also be an indication that Dejean was actually concerned with the Klug names at the time he erected the new genus *Conotrachelus*.

The third evidence is that it seems unlikely that Dejean would publish the same two specific names and ascribe to each the same author as Klug had done unless he was aware of Klug's paper and knew that the species (*diaconitus* and *serpentinus*) therein placed in *Balaninus* were the same as those which he (Dejean) placed in *Conotrachelus* under the same two specific names. It is quite probable that Dejean, Klug, and Germar had even had correspondence (or exchange of specimens and opinions), directly or indirectly, in regard to the two species in question. On this and the two preceding evidences the writer bases his conclusion that the names *Conotrachelus diaconitus* Germ. and *C. serpentinus* Germ.

as given in the Dejean Catalogue (1835) represent valid species, either of which is available as the genotype.

Two of the species originally included under *Conotrachelus* by Dejean have since been removed to another genus. Schönherr (1837, pp. 467 and 468) made *irroratus* (Fab.) the type of a new genus *Peridinetus*, and Chevrolat (1876, p. 229) placed *concentricus* (Oliv.) in the same genus. Both of these species are Barinae, and their removal from the Cryptorhynchinae is correct. Before seeing Klug's paper the writer believed *irroratus* (Fab.) and *concentricus* (Oliv.) to be the only valid species of *Conotrachelus* in the Dejean Catalogue. Under such circumstances the name *Conotrachelus* would be shifted to the Barinae, and the unfamiliar synonym, *Cyphorrhynchus* Schönh., would take its place. Fortunately the Klug paper of 1829 was called to the writer's attention by Mr. L. L. Buchanan, and a consideration of the validity of two other specific names, *diaconitus* Germ. and *serpentinus* Germ., became possible. This consideration has made it possible to retain the name *Conotrachelus* in the Cryptorhynchinae, a retention which is highly desirable in view of the well-known concept built around this generic name.

The type of the genus *Conotrachelus* Dejean is *diaconitus* (Klug), designated by Schönherr (1837, p. 392) as *diaconitus* Germ. The present synonymy of the genus is as follows:

*Conotrachelus* Dejean, 1835, Cat. Col., ed. 2, p. 296.

*Cyphorrhynchus* Schönh., 1837, Gen. Spec. Curc., IV, pt. 1, p. 458.

*Glycaria* Pascoe, 1880, Ann. Mag. Nat. Hist. (5) VI, p. 181.

*Edesius* Pascoe, 1881, Ann. Mag. Nat. Hist. (5) VII, p. 305.

*Loceptes* Casey, 1910, Can. Ent. XLII, p. 130.

The nomenclature of the species, when considered, is discussed under the individual species in the following section.

## VI. CLASSIFICATION

The genus *Conotrachelus* Dejean belongs in the family Curculionidae, subfamily Cryptorhynchinae, and tribe Ithyporini. It is characterized as follows: prosternum grooved, the groove never extending to mesosternum; head not transversely sulcate but with a fovea or feeble depression separating head and beak; antennal funicle with seven segments sparsely clothed with recumbent and suberect pale setae, suberect setae longer and arranged in whorls; prothorax with distinct postocular lobes; ornamental setae or scales present on prothorax and elytra, the latter with intervals 3, 5, 7, and 9 frequently costate, the costae of intervals 3 and 9 meeting apically; femora with one or two teeth on apical ventral surface, tibiae with distinct unci, tarsal claws usually divergent, sometimes approximate, toothed or cleft; fifth abdominal sternum with a small

tuft of pale, erect setae arising from apical third on each side of middle; aedeagus consisting of two heavily sclerotized lateral plates bordering dorsal and ventral median areas which are lightly sclerotized or membranous.

The species of this genus were separated into six groups by Leconte and Horn (1876) and Blatchley and Leng (1916). In the present classification only four groups are designated. These groups are erected not only for convenience of treatment, but also to exhibit the phylogenetic relations of the species more clearly.

Each species is described or redescribed on both the external morphological structures and the male genitalia. The redescrptions of previously described species are necessary because older descriptions omitted many of the characters now in use and several of them were based only on one sex. The citations under each specific name are those which have included descriptions of the species. Characters mentioned in the keys and diagnoses (special characters) are usually not repeated in the specific descriptions. Each description is followed by a brief discussion of the distribution, biology, phylogeny, or nomenclature of the species involved. The present locations of the type specimens are indicated by the capital letters inclosed in parenthesis at the end of the type citations. The explanation of these abbreviations is on p. 16. A brief glossary is given on p. 142.

#### KEY TO THE GROUPS OF CONOTRACHELUS

1. Tarsal claws divergent..... 2
- 1- Tarsal claws approximate.....Group IV, p. 129
2. Dorsum of prothorax without a median longitudinal furrow; apical half never with a longitudinal ridge on each side of the middle..... 3
- 2- Dorsum of prothorax with a median longitudinal furrow on the apical half; furrow bordered on each side by a longitudinal ridge; ridges and furrow sometimes feeble; if so, specimens will have an oblique bar of yellowish vestiture behind each humerus.....Group III, p. 118
3. With two femoral teeth, rarely one absent; if only the distal femoral tooth is present, the protibia will be distinctly concave apically (Fig. 31a), or, if the proximal tooth is distinct and the distal tooth obsolete, then the elytral vestiture will be dense and conspicuously white and brown in color.....Group I, p. 40
- 3- With one femoral tooth (sometimes feeble); if femora also possess a minute distal tooth, the elytral intervals will be set with numerous erect setae, but the elytra will never have a dense vestiture of white and brown recumbent setae, and the protibiae will never be concave apically.....Group II, p. 94

#### GROUP I

The species of this group possess the following characteristics: two femoral teeth (proximal tooth in *tibialis* n. sp. and distal tooth in *nivosus* Lec. sometimes obsolete); first and second funicular segments of antennae



subequal in length and each longer than any of the succeeding segments; prothorax wider than long, with basal border bisinuate; elytral intervals 3, 5, 7, and 9 feebly to acutely costate; costa of interval 3 usually twice interrupted except in *falli* Blatch., *nivosus* Lec., and rarely *elegans* (Say); costa of interval 7 interrupted once or complete, that of interval 9 complete, extending from before base to near apex, where it is broader, less distinct, and united with costa of interval 3; interval 10 with a short basal elevation or costa; striae feebly impressed or lacking, more evident apically, succeeded by serial punctures, the latter usually more evident on basal half; vestiture usually condensed posteriorly to form a vague to prominent postmedian band; elytral intervals usually lacking suberect or erect setae; metasternum in males frequently grooved from meso- to metacoxa (Fig. 13); aedeagus with a dorsal plate (except in *nivosus* Lec.), this plate being separated apically from lateral plates by membranous areas (except in *seniculus* Lec.); transfer apparatus (except in *nivosus* Lec. and *seniculus* Lec.) with two roughly diamond-shaped plates (Fig. 4).

This group is commonly known as the “*nenuphar* group.” The designation, however, appears to be a misnomer as only part of the group (species *juglandis* Lec. to *iowensis* n. sp.) is closely related to *nenuphar* (Hbst.). In addition, the remaining species fall into more or less closely related groups (*retentus-affinis*; *elegans-aratus*). Consequently, from a phylogenetic viewpoint it would appear desirable to consider the group only as Group I, omitting any designation of a “typical” species.

#### KEY TO SPECIES OF GROUP I

1. Abdominal sterna 3 and 4 with distinct, coarse punctures, density variable; elytral costa of interval 3 twice interrupted to form three, usually abrupt, elevations, of which the median one is usually hump-like and prominent..... 2
- 1- Abdominal sterna 3 and 4 with sparse, feebly impressed, fine punctures or with coarse punctures; if punctures are coarse the elytral costa of interval 3 (sometimes feeble) will be complete, once interrupted posteriorly, or twice interrupted and forming three feeble elevations, of which the median one is never hump-like and prominent; if specimens are less than 4 mm. and have a cream-colored postmedian elytral band and a depressed mesoscutellum, see Couplet 2; or if specimens have their elytral costae feeble and obscured by a dense, principally white and brown vestiture, see Couplet 10..... 6
2. Abdominal sternum 2 and usually sterna 3 and 4 sparsely punctate; mesoscutellum prominent; aedeagus with a feeble broad apical process (Figs. 42 and 69); size 5.9-7.1 mm..... *juglandis* Leconte, p. 44
- 2- Abdominal sterna 2 to 4 usually coarsely and densely punctate; if punctures are not dense, species will have a depressed mesoscutellum; size 3.2-6.0 mm..... 3
3. Mesoscutellum depressed, from lateral aspect gradually sloping downward basally (Fig. 29b)..... 4

- 3- Mesoscutellum prominent, from lateral aspect abruptly declivent basally (Fig. 30b)..... 5
4. Postmedian band of elytra consisting of reddish-brown or reddish-yellow and white recumbent setae; discal area between median elevations of costae of interval 3 intensely black and usually devoid of vestiture; males only with large dentate metaunci (Fig. 21); aedeagus with distinct apical process (Fig. 43).....*nenuphar* (Herbst), p. 48
- 4- Postmedian band of elytra consisting of all dirty white or cream setae, not mixed with reddish-brown or reddish-yellow setae; discal area between median elevations of costae of interval 3 with sparse to moderately dense vestiture; this area piceous but never intensely and prominently black; both sexes with non-dentate metaunci; aedeagus without an apical process. (Figs. 44 and 71).....*buchanani* new species, p. 51
5. Postmedian band of elytra composed of pure white setae and always extending laterally to costae of interval 7, usually to costae of interval 9; aedeagus as shown in Figs. 45 and 72.....*albicinctus* Leconte, p. 54
- 5- Postmedian band of elytra composed of reddish-yellow and white setae, the latter chiefly confined to the transverse discal area between the fifth intervals; aedeagus as shown in Figs. 46 and 73....*iowensis* new species, p. 57
6. Abdominal sterna 1 to 4 with sparse, fine, feebly impressed punctures; sternum 1 frequently with coarser punctures along the base; sterna 3 and 4, in particular, smooth and with the feebly impressed punctures usually few in number..... 7
- 6- Abdominal sterna 1 to 4 with distinct coarse punctures; punctuation usually dense, sometimes approaching moderate to sparse, but in such cases sterna 3 and 4 bear distinct, usually numerous, punctures..... 9
7. Postmedian elytral band obscure, composed of a mixture of brown and white setae (sometimes almost entirely of brown setae); setae of band usually not distinctly denser than those of area posterior to band; elytral costae of intervals 3 and 5 always twice interrupted; metaunci of male dentate or not dentate, those of female not dentate (Fig. 22); aedeagus with a narrow apical process (Fig. 47).....*retentus* (Say), p. 60
- 7- Postmedian elytral band usually distinct, between fifth intervals composed principally of white or light tannish setae or a mixture of the two, sometimes with a few brownish setae; band laterad of interval 5 sometimes less distinct and composed in part of brownish setae; setae of band distinctly denser than those of area posterior to band; elytral costa of interval 3 twice interrupted, that of interval 5 complete or interrupted once or twice; metaunci of male as in Figs. 23 and 24; aedeagus with a broad apical process (Fig. 48) or without a process (Fig. 49)..... 8
8. Male: metaunci feebly dentate or not dentate (Fig. 24); aedeagus with a broad apical process (Fig. 48); female: metaunci non-dentate; antennal scape distinctly not reaching head capsule (Fig. 36a), the distance between scape and head capsule at least one-half and usually two-thirds to three-fourths the length of first funicular segment of antenna .....*affinis* Boheman, p. 65
- 8- Male: metaunci distinctly dentate as shown in Fig. 23; aedeagus without an apical process (Fig. 49); female: metaunci non-dentate; antennal scape almost reaching head capsule (Fig. 36b), the distance between scape and head capsule less than one-half the length of first funicular segment of antenna.....*hicoriae* new species, p. 69
9. Elytral costa of interval 3 evident and complete, rarely with a feeble interruption near apical declivity; prothoracic dorsum without a longitudinal

- oblique line of vestiture on each side; elytral vestiture sparse; aedeagus as shown in Figs. 50 and 77.....*falli* Blatchley, p. 72
- 9- Elytral costa of interval 3 nearly always twice interrupted, rarely without anterior interruption; when latter is lacking, prothoracic dorsum will have a longitudinal oblique line of vestiture on each side; sometimes, especially when elytral vestiture is dense and principally white and brown, the elevations formed by the interruptions are exceedingly feeble and obscure..... 10
10. Elytral costae feeble and obscured by dense, principally whitish vestiture; beak stout and shorter than non-carinate prothorax; aedeagus distinctly elongate, with an apical process but without a dorsal plate (Fig. 55) .....*nivosus* Leconte, p. 73
- 10- Elytral costae usually distinct; elytral vestiture rarely dense; when dense, never in a large part white; beak usually longer than prothorax; when shorter, prothorax usually distinctly carinate; aedeagus, if elongate, without an apical process and with a distinct dorsal plate (Figs. 52 and 56)..... 11
11. Prothorax with a prominent longitudinal median carina and with two broad, deep depressions just behind the middle, one on either side of the carina; the oblique lines of vestiture on prothorax meeting in front; aedeagus elongate without an apical process and with an elongate dorsal plate (Fig. 56) .....*seniculus* Leconte, p. 76
- 11- Prothorax feebly or not at all carinate; the oblique lines of vestiture on prothorax approaching but not meeting apically; aedeagus with or without an apical process but always with a broad dorsal plate (Figs. 52 and 53)..... 12
12. Male: both meso- and metaunci dentate (Fig. 25); aedeagus as shown in Figs. 51 and 78; female: all unci non-dentate; beak elongate, slightly curved (Fig. 39); the distance (a) between lateral apical emargination of beak and anterior margin of ball of antennal scape more than 1.5 times the distance (b) between dorsal and ventral surfaces of beak at position of antennal insertion (Fig. 105); first and second abdominal sterna densely punctate (Fig. 33); postmedian elytral band distinct in both sexes.....*elegans* (Say), p. 80
- 12- Male: metaunci dentate; mesounci not dentate; aedeagus as shown in Figs. 52, 53, or 54; female: all unci non-dentate; beak stout, curved (Fig. 41), the distance (a) being less than 1.5 times the distance (b); or beak slender (Fig. 40), in which case distance (a) is approximately 3 or more times distance (b) and the first and second abdominal sterna are moderately, never densely, punctate (density similar to that shown in Fig. 34); postmedian elytral band ill-defined and usually faint in both sexes..... 13
13. Beak elongate and slightly curved as shown in Figs. 37 and 40, never stout; fifth abdominal sternum at the most with two feeble tubercles; males without metasternal grooves between meso- and metacoxae and with the apical areas of the protibiae not compressed and not concave anteromedially; aedeagus elongate, without an apical process (Fig. 52).....*hayesi* new species, p. 85
- 13- Beak always stout and curved as shown in Figs. 38 and 41, sometimes shorter in male than shown in Fig. 38; fifth abdominal sternum usually with two distinct tubercles; males with or without metasternal grooves (Fig. 19); if grooves are absent, specimens will have apical portion of protibia compressed and concave anteromedially (Fig. 31a); aedeagus subrectangular with an apical process (Figs. 53 and 54)..... 14



14. Protibia of male normal (Fig. 31b); protibia of female with anterior surface at apical seventh not sloping medially, either convex or flattened; the oblique apical carina bearing the spinulae evident but not prominent; anterior aspect one-seventh before the apex not smooth, although the small ridges of the remainder of the tibia may be less distinct here, or shiny; usually with a distinct, though irregular, row of pale amber setae above the apical carina; aedeagus with apical process as in Fig. 53 .....*aratus* (Germar), p. 88
- 14- Protibia of male compressed to form a median ridge on apical area of anterior surface, anteromedial apical surface distinctly concave (Fig. 31a); protibia of female with anterior surface at apical seventh sloping downward medially; the oblique apical carina bearing the row of prominent spinulae from lateral margin to uncus usually distinct, especially laterodorsally; anterior aspect, one-seventh before apex, usually smooth and shiny; pale amber setae in this area usually few and difficult to see; aedeagus with apical process as in Fig. 54 .....*tibialis* new species, p. 91

*Conotrachelus juglandis* Leconte

*Conotrachelus juglandis* Leconte, 1876, Rhynchophora N. A., Proc. Amer. Philos. Soc., XV, No. 96, p. 226; Blatchley and Leng, 1916, Rhynchophora N. E. Amer., p. 468; Mutchler and Weiss, 1925, Conotr. N. J., Circ. 87, Bur. Stat. and Insp., Dept. Agr., N. J., p. 19.

*Length:* 5.9-7.1 mm.

*Special characters:* Elytra with a distinct, broad postmedian band, usually composed of whitish setae, sometimes a mixture of whitish and tannish setae; abdominal sternum 1 usually finely punctate.

*Color:* Prothorax, elytra, and abdomen reddish to black.

*Head:* Densely and evenly punctate; sparsely covered with brownish-yellow setae, posterior setae finer; beak curved for its entire length; longer than the prothorax, usually longer in female (2.00-2.37 mm.) than in male (1.75-2.05 mm.); in male dull, with three punctate, lateral sulci between base and antennal insertion, the median sulcus distinct apically but obscure basally, sometimes entirely obscure and replaced by punctures; dorsal surface broadly carinate from base to distad of middle, finely punctate; punctures dense distad of antennal insertion, coarser towards base and entering sulci; beak in female usually shining (sometimes dull), sulcate laterally, the lower sulcus distinct, the median and upper sulci being feeble and not extending more than halfway between base and antennal insertion; dorsal surface with a broad obscure carina basally, and with fine scattered punctures, the latter towards the base concentrated along the edges, coarser, and entering the sulci; sparse vestiture of brownish-yellow setae from base to distad of middle; in female setae chiefly in lowermost sulcus; antennae inserted approximately one-fourth from apex.

*Prothorax:* Sides widened for a short distance, narrowed up to one-third before apex, then suddenly constricted, sometimes smoothly rounded

from base to one-third before apex, instead of being angulate in outline on basal two-thirds; densely, coarsely, and unevenly punctate; disc with four tubercles (sometimes faint), one pair transversely at the middle, the other between median pair and base; a short carina extending from between median tubercles to apex, broad at base, narrowed toward apex; sparse vestiture of brownish-yellow and white elongate recumbent to subrecumbent setae; white setae on each side condensed into a sinuate, irregular line extending from basal angle to near apex; lines approach apically but do not meet; brownish-yellow setae more elongate than white ones.

*Mesoscutellum*: From lateral aspect, abruptly declivent basally.

*Elytra*: More than two-thirds as wide as long; sides subparallel for approximately one-half, then gradually converging to apex; basal border emarginate before humeri; humeri obliquely rounded and prominent; median elevation of interval 3 much more prominent than either of the other two and twice as long as posterior one; broad costa of interval 5 interrupted twice, elevations not as prominent as those of interval 3; costa of interval 7 narrower than those of intervals 3 and 5; serial punctures coarser on basal half, surface rough in appearance; sparse vestiture of brownish, brownish-yellow, and white elongate recumbent setae except posteriorly where whitish (dirty white or creamish) setae, sometimes mixed with tan ones, are condensed in a broad postmedian band; whitish setae also condensed at base of intervals 3 and 5; the line formed at base of interval 5 one-fourth the length of that at base of interval 3; remainder of vestiture mostly of brownish setae.

*Ventral surface*: Metasternum in male grooved from meso- to metacoxa (Fig. 19); groove absent in female. Abdomen shiny; sternum 1 finely punctured except for coarse punctures along anterior margin; coarse punctures sometimes in a single row, especially laterally, fine punctures rather dense medially but sparse laterally; sternum 2 sparsely and finely punctate; punctures of sterna 3 and 4 sparse to moderately dense and slightly coarser than those of sternum 2; sternum 5 more finely and densely punctate, punctures on basal border coarser, resembling those of preceding sternum, without tubercles; punctures each with a reddish-brown seta; lateral setae broader and light brownish-yellow and white in color, forming patches on sterna 2, 3, 4, and 5.

*Legs*: Metaunci of male dentate; those of female not dentate; legs with sparse vestiture of brownish-yellow and white setae; metafemora annulated with white setae, pro- and mesofemora feebly so.

*Male genitalia*: (Figs. 42 and 69). Aedeagus subelongate, nearly twice as long as wide and distinctly longer than the aedeagal struts, apex bisinuate to form a slight apical process; dorsal plate may or may not

extend under lateral plates, feebly prolonged to base; inner curvature at apex sometimes more angular than in Fig. 42. Length 1.03-1.06 mm., width at base .524-.572 mm., aedeagal struts .562-.687 mm.

*Type locality*: "Middle States."

*Lectotype*, hereby designated: Female, Museum of Comparative Zoology Type No. 5217-1, J. L. Leconte Collection (MCZ).

*Lectoparatype*: Female, M. C. Z. Type No. 5217-2, "Middle States," J. L. Leconte Collection (MCZ).

*Distribution*: "Ranges from Canada and New England west to Kansas, southwest to Texas and Louisiana, and south to Georgia," Britton and Kirk (1912). Records from: Canada (Montreal), Connecticut, District of Columbia, Illinois, Indiana, Iowa, Kansas, Kentucky, Maryland, Massachusetts, Michigan, Missouri, New Jersey, New York, North Carolina, Ohio, Pennsylvania, Virginia, West Virginia, Wisconsin.

*Biology*: The habits and biology of *C. juglandis* Lec. are better known than those of most species of *Conotrachelus*, Brooks (1922) and Britton and Kirk (1912) having made extensive studies on this curculio in West Virginia and Connecticut.

Commonly known as the butternut curculio, *juglandis* Lec. attacks various species of *Juglans*. Britton and Kirk (1912) list its hosts in order of preference as: *Juglans cordiformis* (heartnut), *J. sieboldiana* (Siebold's walnut), *J. cinerea* (butternut), *J. regia* (Persian or English walnut), *J. nigra* (black walnut), and *J. mandshurica* (Japanese walnut). The curculio attacks both the fruits and the stems of the first four hosts, but only the stems of the two last-named species. Brooks (1922) records *juglandis* Lec. doing serious damage to the fruits of *J. cinerea* and to the shoots and leaf petioles of *J. sieboldiana* and *J. cordiformis*. This worker also found adult curculios on the branches of *J. cathayensis*, and at the same time noted evidences of earlier larval injury to the branches.

The injury produced by the butternut curculio is brought about by the feeding of the adults in the nuts, tender tips, and leaf petioles, and by the burrowing of the larvae in the nuts, young shoots, leaf petioles, and stems. In the spring the adults make large punctures in the leaf, stems, and young shoots, sometimes causing them to wilt and die. Of more consequence, however, is the larval injury to the stems and branches. This type of injury is most serious on *J. sieboldiana* and *J. cordiformis*; *J. regia*, *J. cinerea*, and *J. nigra* being slightly or not at all attacked in this manner. In Connecticut small trees in nurseries and young transplanted trees have been severely and sometimes fatally damaged by larvae tunneling in the new growth. In some instances the new shoots were killed entirely back to the old wood. Brooks found similar serious injury to young trees in Massachusetts and New York.



Larval injury to the nuts is more extensive southward in Maryland and West Virginia where *J. cinerea* is most seriously attacked, *J. sieboldiana* and *J. cordiformis* showing only light infestations. Brooks (1922) states, "Many cases have been observed in which 50% or more of the nuts dropped from the trees prematurely on account of injury by the curculio larvae, the percentage of loss being greatest in years of light crops."

The butternut curculio passes the winter in the adult stage, probably in ground litter. In West Virginia the curculios appear at the time the walnut trees bloom and commence feeding upon the stems and leaf veins. After mating, the females begin oviposition, the first eggs being laid in the new growth, the later ones in the nuts. In *J. cinerea* the majority of the eggs are deposited in the nuts. At first the eggs are placed in crescent-shaped marks near the blossom end of the nuts, but later when the husks are tougher they are inserted in simple, gouged-out cavities in the side of the nut. The resultant larvae feed in the shoots and in the nuts, becoming full grown in 4 to 5 weeks, at which time they leave the host and enter the ground 1 to 3 inches for pupation. From one to six larvae develop in a nut, depending on its size. The curculio spends almost a month in the soil as a prepupa and pupa. On issuing from the ground in late summer and early autumn, the adults fly to the trees and feed on the leaf petioles and terminal shoots in a manner similar to that of the parent generation. With the oncoming of freezing weather the curculios go into hibernation.

Brooks (1922) lists six larval parasites of *juglandis* Lec.: *Chaetochlorops inquilina* Coq., *Cholomyia longipes* Fab., *Metadexia basalis* G.-T., *Cholomyia inaequipes* Bigot, *Myiophasia aenea* Wied., and *Sigalphus curculionis* Fitch. Of these six species Brooks reared the first two in abundant numbers.

In addition to the previously mentioned hosts, there are a few records in the literature of the occurrence of this species on hickory (Blatchley and Leng, 1916, and Britton and Kirk, 1912). Champlain and Knull (1921) question its occurrence on hickory, stating that it breeds in the leaf stems of walnut and butternut. Blatchley (1925), after collecting this species at Dunnedin, Florida, states (in reply to Champlain and Knull): "As the only species of Juglandaceae growing around Dunnedin belong to the genus *Hicoria* the weevil must breed in them if it is limited to that family for a host plant." From the available data its occurrence on hickory appears to be questionable.

Although Brooks (1922) states that he found no indication of *juglandis* Lec. breeding in *J. nigra*, Britton and Kirk (1912) record it as attacking that species. One specimen record substantiates the latter statement: "Reared from black walnuts" (Pa., Dr. Massey).

The butternut curculio has been collected "at lights" by H. S. Barber at Plummer's Island, Maryland.

*Remarks:* *C. juglandis* Lec. differs from all other species in the primary subdivision of Group I by its sparse and fine punctation of the second, and usually the third and fourth, abdominal sterna. The dentate metaunci of the male indicates an affinity with *nenuphar* (Hbst.), but by genital characteristics *juglandis* Lec. and *buchanani* n. sp. seem more closely linked. The occurrence of this type of divergent affinity is prevalent in this primary division of Group I, and consequently definite phylogenetic placements of the species cannot be made.

That Leconte (1876) had only female specimens before him when he described *juglandis* is indicated by his description of the beak as being sparsely punctate and bearing a broad, lateral groove and two short, finer, basal ones. Examination of Leconte's cotypes verifies this viewpoint. Blatchley's description in 1916 similarly indicates his examination of only female specimens.

This insect was first recognized as possibly distinct from *C. nenuphar* (Hbst.) by B. D. Walsh (1868), who sent specimens to Leconte, but the latter diagnosed them merely as large varieties of *nenuphar* (Hbst.). Walsh, however, never found this new form in stone fruits nor *nenuphar* (Hbst.) in walnuts and, therefore, still considered the two as distinct species, calling the walnut-infesting curculio a "phytophagic species." He did not, however, describe his phytophagic species. Leconte (1876) recognized the walnut-infesting form as distinct from *nenuphar* (Hbst.) and described it as *juglandis*.

#### *Conotrachelus nenuphar* (Herbst)

*Curculio nenuphar* Herbst, 1797, Kafer, Natursystem aller Insekten, VII, p. 29.

*Conotrachelus nenuphar* (Hbst.) Leconte and Horn, 1876, Rhynchophora N. A., Proc. Amer. Philos. Soc., XV, No. 96, p. 227; Provancher, 1877, Faune Ent. Can. I Col. p. 529; Blatchley and Leng, 1916, Rhynchophora N. E. Amer., p. 469.

*Rhynchaenus argula* Fabricius, 1801, Syst. Eleut. II, p. 467.

*Cryptorhynchus argula* (Fab.) Say, 1831, Desc. N. A. Curc. New Harmony, Indiana, p. 19, in Writings of Thomas Say, ed. Leconte, 1859, p. 285; Fahreus, 1837, Schönh. Gen. Spec. Curc., IV, pt. 1, p. 425.

*Rhynchaenus cerasi* Peck, 1819, Mass. Agric. Repos. and Journ., V, p. 312.

*Length:* 3.6-5.4 mm.

*Special characters:* Abdominal punctation of sterna 1 and 2 exceedingly dense; numerous punctures frequently more oblong than circular in outline; postmedian elytral band usually not prominent, the white setae confined mesad of interval 4.

*Color:* Prothorax and elytra red and black mixed, proportion of each varying greatly in different specimens.

*Head*: Semi-coarsely punctate; with sparse vestiture of reddish-brown and white setae; basal setae finer; beak strongly curved (Fig. 35); curvature more abrupt apically in male; beak approximately as long as prothorax, equal in length in both sexes; three lateral sulci between base and antennal insertion; the median sulcus sometimes faint or replaced by large, shallow punctures; dorsal surface with a feeble, broadly rounded carina from base to distad of middle, usually more evident in male; area distad of carina with sparse to dense elongate punctures, those of female sometimes fine; sparse vestiture of reddish-brown and white setae proximad of antennal insertion, setae arising from sulci; antennae inserted approximately one-fourth to one-third before apex of beak, insertion in females usually nearer one-third, that of males usually nearer one-fourth.

*Prothorax*: Sides feebly rounded or subparallel, with an apical constriction; densely, coarsely, and roughly punctate; four tubercles on disc, one pair transversely at the middle, the other between median pair and base; median pair prominent, much more so than posterior pair which is sometimes evanescent; area between median and posterior tubercle on each side sometimes depressed; disc carinate longitudinally from between median tubercles to apex; carina varying from distinct to feeble, sometimes extending to posterior tubercles; sparse vestiture of reddish-brown to yellow and white, elongate, recumbent to subrecumbent setae; white setae on each side condensed into a sinuate line from inside the basal angle to before apex; lines approach but do not meet apically; apical portion of white lines sometimes lacking, so that remaining basal portions appear as two short, distinct bars; remainder of vestiture chiefly reddish-brown with a few patches of white; white markings of the vestiture not always prominent in dried specimens.

*Elytra*: Approximately two-thirds as wide as long; sides subparallel for more than half, then gradually converging to apex; humeri obliquely rounded, prominent; basal border emarginate before humeri; the median elevation of interval 3 distinctly more prominent than others; costa of interval 5 twice interrupted, with median elevation most prominent but less so than median one of interval 3, posterior elevation longer than either anterior or median elevations; interval 7 usually with costa more acute than those of intervals 3 and 5; serial punctures large on basal half but not always distinctly impressed; sparse vestiture of brown, reddish-brown, reddish-yellow, and white recumbent setae, the reddish-yellow and white setae forming a postmedian band in which white setae are chiefly confined to the transverse discal area between the third intervals, the patch at base of posterior elevation of interval 3 sometimes extending over into interval 4; postmedian band usually not prominent



(white setae rarely absent in band); white setae also condensed in a line at base of intervals 3 and 5.

*Ventral surface:* Metasternum in male grooved from posterior margin of mesocoxa to anterior margin of metacoxa (Fig. 19); groove absent in female. Abdominal sterna with even, coarse, and extremely dense punctation; punctures with scarcely any space between them, especially on sternum 2, and tending to be confluent in many areas; sternum 5 with punctures smaller than those of preceding sterna and with lateral depressions, but occasionally depressed medially, with feeble to prominent tubercles; each puncture with a fine reddish-brown seta, except laterally and on the basal border of sternum 5, where setae are broader and reddish-yellow; lateral setae forming patches on sterna 2 to 5.

*Legs:* Proximal femoral tooth larger; in male metaunci broad and dentate (Fig. 21), in female narrow and non-dentate; all tibiae in female minutely but distinctly mucronate proximad of uncus; legs sparsely clothed with elongate reddish-brown, reddish-yellow, and white setae; metafemora with a dense patch of reddish-yellow to yellow setae at position of teeth.

*Male genitalia:* (Figs. 43 and 70). Aedeagus approximately one-third longer than wide, and approximately one-third longer than aedeagal struts; apex of aedeagus with a narrow process, lateral emargination of outer curvature variable in distinctness, sometimes lacking; dorsal plate may be wider than in Fig. 43. Length .596-.673 mm., width at base .387-.423 mm., aedeagal struts .349-.423 mm.

*Type locality:* North America.

*Type:* Probably in Zool. Mus. Berlin.

*Distribution:* "Ranges from Nova Scotia to Manitoba and Colorado, south to Largo, Florida, and the eastern half of Texas," Chapman (1938). There is also a record by Cooley (1922) of its occurrence in Bitter Root Valley, Montana, and the writer has one specimen labelled "Mon." *C. nenuphar* (Hbst.) is the most abundant species in the genus, and no individual locality records were kept for it.

*Biology:* Since this species is of much economic importance, there is available a mass of literature pertaining to its life history, food plants, distribution, natural enemies, and control. The reader is referred to Chapman (1938), Snapp (1930), and Quaintance and Jenne (1912) for details of the biology of *C. nenuphar* (Hbst.). It appears desirable, however, to mention that the following types of fruits have served as hosts: plum, cherry, peach, nectarine, apple, wild crabapple, pear, and quince. It has also been reported by Quaintance and Jenne (1912) as occasionally ovipositing in the fruits of huckleberry, grape, strawberry, currant, gooseberry, and persimmon. In addition, Chapman (1938) states that it has

been found breeding in the callous tissue formed on plums affected with black knot disease. This report agrees with the following data found on a specimen from Bar Harbor, Maine: "Bred August 27, 1935, black knot cherry, reared, breeding in fleshy part of fungus, 2 more ex. (♀) in Coll. W. E. Brower."

*Remarks:* This species is closely allied to *juglandis* Lec., *buchanani* n. sp., *iowensis* n. sp., and *albicinctus* Lec. The narrow apical process of the aedeagus in *nemuphar* (Hbst.) is a character not found in these four species and serves to indicate that on the basis of the male genitalia *nemuphar* (Hbst.) is not as closely related to these species as they are to each other. The characters in the key will readily separate *nemuphar* (Hbst.) from its allied species.

*Conotrachelus buchanani* n. sp.

*Length:* 3.1-5.4 mm.

*Special characters:* Postmedian band of elytra prominent and extending laterad of interval 5; abdominal sternum 1 usually so densely rugulose that coarse punctures in median area are less evident than those of succeeding sterna.

*Color:* Prothorax and elytra piceous, black, and reddish-brown mixed.

*Head:* Semi-coarsely and densely punctate; clothed with white and brownish-yellow elongate setae, sometimes so densely as to obscure punctures; beak distinctly curved for its entire length; longer than prothorax, equal in length in both sexes; trisulcate laterally between base and antennal insertion; upper and lower sulci distinct; median sulcus usually obscure basally; lower sulcus occasionally dividing basally; sulci punctate; dorsal aspect broadly and feebly carinate from base to distad of middle; area distad of carina with elongate, fine punctures, variable in density; surface sometimes smooth medially; sparse vestiture of whitish and brownish-yellow elongate setae on basal two-thirds; antennae inserted one-fourth to one-third from apex.

*Prothorax:* Sides usually subparallel and constricted subapically, occasionally slightly rounded; coarsely, densely, and unevenly punctate; disc with four tubercles, one pair transversely at middle, the other between median pair and base; median pair more prominent; a short, median, longitudinal carina (frequently feeble and vague) from between anterior tubercles to before apex; sparse to moderately dense vestiture of brown, brownish-yellow, and white elongate recumbent to subrecumbent setae; whitish and light-yellowish setae on each side, forming a sinuate line from basal angle to near apex, each line also sending a branch medially, the branches from each side uniting between the median pair

of tubercles; lines sometimes obscure (especially in specimens 3-4 mm.) or broken up into separate sections; brownish and yellowish setae usually more elongate than white ones.

*Elytra:* More than two-thirds as wide as long; sides subparallel for approximately one-half, then gradually converging to the apex; humeri obliquely rounded and prominent; basal border emarginate mesad of humeri; elevations of interval 3 varying in prominence, the median elevation being twice as long as the posterior one and the most prominent; broad costa of interval 5 twice interrupted, with median elevation sometimes not distinctly separated from anterior one; anterior, especially, and occasionally median, elevation feeble; costa of interval 7 narrower and less prominent than preceding ones, interrupted once behind the base; serial punctation coarse, most evident basally; moderate to dense vestiture (sometimes rather sparse but specimens appear rubbed) of brown, brownish-yellow, and dirty white elongate recumbent setae; the whitish, usually cream, setae condensed in a broad postmedian band and in a longitudinal line at base of intervals 3 and 5; the line of vestiture of interval 3 twice the length of that of interval 5; remainder of vestiture mostly of brown and brownish-yellow setae with scattered patches of white.

*Ventral surface:* Metasternum in male feebly grooved from meso- to metacoxa; groove absent in female. Abdomen with sterna 1 to 5 moderately to densely punctate (in specimens 3-4 mm. punctation of sterna 2, 3, and 4 sometimes approaching sparse); sterna 2 to 4 and occasionally 5 sometimes less densely punctate than sternum 1, the latter usually more coarsely punctate than the succeeding sterna; sternum 5 with two feeble to distinct tubercles; each puncture with a fine reddish-brown or amber seta; lateral setae broader and white or yellow in color, forming small patches on sterna 2 to 5; broader setae of fifth sternum more closely approaching the median line.

*Legs:* Proximal femoral tooth usually broader at base than distal one; female with a small mucro proximad of uncus, most evident on protibiae; male without mucrones; legs sparsely covered with brownish-yellow and whitish setae; metafemora usually distinctly annulated with dirty white and yellow elongate setae; pro- and mesofemora faintly ringed.

*Male genitalia:* (Figs. 44 and 71). Aedeagus subrectangular dorsally, one-fourth to one-third longer than wide at the base and one-fourth to one-half longer than the aedeagal struts; apex bisinuate and with a feeble process; laterally, ventral curvature smooth from base to apex. Length .386-.687 mm., width at base .250-.471 mm., aedeagal struts .250-.500 mm.

This species is named for Mr. L. L. Buchanan of the United States National Museum.



*Type locality:* New Braunfels, Texas.

*Holotype:* Male, June 27, 1895, H. Soltau, United States National Museum Type No. 54307 (USNM).

*Allotype:* Female, San Antonio, Texas, June 24, 1895, H. Soltau (USNM).

*Paratypes:* DISTRICT OF COLUMBIA, ♂, (USNM); ILLINOIS: Urbana, Univ. of Ill. Woods, Sept. 11, 1937, Shrubs, ♂, (HFS); IOWA: Lake Okoboji, July 1, 1916, L. L. Buchanan, ♀, (USNM); KANSAS: Topeka, Ac. No. 976, Popenoe, ♂, (USNM); Onaga, July 8 and 21, Wickham, 1 ♂, (WPH), 2 ♂, (USNM); Kansas, T. B. A., ♀, (WPH); Riley Co., June, Marlatt, ♀, (WPH); MARYLAND: Plum Point, May 28, 1922, L. L. Buchanan, ♂, (HFS); NEW JERSEY: Riverton, Sept. 11, 1898, Geo. M. Greene Collection, ♂, (USNM); TEXAS: New Braunfels, June 27, 1895, H. Soltau, 4 ♂, 1 ♀, (USNM); Dallas, July, 1907, W. W. Yothers, ♂, (USNM); Dallas, March 15, 1908, and March 18, 1909, F. C. Bishopp, 3 ♂, (USNM), 1 ♀, (HFS); San Antonio, June 24, 1895, H. Soltau, 1 ♂, 2 ♀, (USNM); Kerrville, April 27, 1908, on pecan, F. C. Pratt, ♂, (USNM); Columbus, June 2, H. Soltau, 2 ♀, (USNM); Brownsville, May 13 and 29, 1904, H. Soltau, 2 ♀, (USNM).

*Distribution:* Ranges from New Jersey and Pennsylvania south to Louisiana, southwest to Texas, and west to Utah. Common in eastern Texas. Locality records from specimens not in type series: District of Columbia, Illinois (Galesburg), Louisiana (New Iberia), Maryland (Plummer's Island), Missouri (Sedalia, Kansas City), Ohio (Cincinnati), Pennsylvania, Texas (Austin, Alpine, Victoria), Utah, and Virginia (Acquia, Middletown, Nelson County, Fairfax County).

*Biology:* Two specimen records here cited indicate that *buchanani* n. sp. is associated with hackberry: "Celtis" (Plummer's Island, Md., A. D. Hopkins) and "on *Celtis mississippi*" (Victoria, Texas, J. D. Mitchell). Since this species and *albicinctus* Lec. heretofore have been considered as one species, the few literature records listed under *albicinctus* Lec. (p. 56) are also applicable to *buchanani* n. sp.

*Remarks:* This species is closely allied to *albicinctus* Lec. and has previously been identified as that species. It is distinguished from *albicinctus* Lec. by the shape and slope of the mesoscutellum, as stated in the key. Usually *buchanani* n. sp. also has a denser vestiture of the prothorax and of the elytra, especially on interval 3 anterior to the median elevation. Males of these two species are easily separated by their genitalia. From a study of Leconte's specimens it is evident that he considered both *buchanani* n. sp. and *albicinctus* Lec. as *albicinctus* Lec., and a discussion of which species is *albicinctus* Lec. appears under that species (p. 56).

The great range in size variation in this species, from 3.1 to 5.4 millimeters, at first was thought to indicate a size variety, since the specimens on hand could be distinctly divided into two groups, one above 4.1 millimeters and the other below 3.8. When other specimens became available, however, this distinction disappeared and consequently no varieties have been erected. Specimens at the extremes of length seem distinct, but in a long series one series can be shown to merge into the other.

*Conotrachelus albicinctus* Leconte

*Conotrachelus albicinctus* Leconte, 1876, Rhynchophora N. A., Proc. Amer. Philos. Soc., XV, No. 96, p. 226; Blatchley and Leng, 1916, Rhynchophora N. E. Amer. p. 469.

*Length:* 3.9-4.8 mm.

*Special characters:* Postmedian elytral band broad longitudinally and prominent, composed of white setae; sometimes in areas where white setae have been rubbed off a few yellowish setae are visible; when vestiture of band is complete, however, it is pure white in appearance.

*Color:* Prothorax and elytra piceous to black.

*Head:* Coarsely and densely punctate; sparsely covered with brownish-yellow, yellow and white elongate setae; basal setae finer; beak curved from base to apex; longer than prothorax, equal in length in both sexes; three lateral sulci between base and antennal insertion; median sulcus obscure toward the base; sulci varying in depth in different specimens, sometimes being very feeble, especially toward the base; sulci punctate; dorsal surface broadly carinate from base to over half its length; area distad of carina in male with fine elongate punctures; in female shining, more finely and less densely punctate; sparse covering of brownish-yellow and white setae from base to distad of middle; antennae inserted approximately two-sevenths from apex of beak.

*Prothorax:* Sides subparallel, then constricted apically; sometimes rounded from base to apical constriction; coarsely, densely, and unevenly punctate; with four tubercles, one pair transversely at middle, the other between median pair and base, with median pair most prominent; a feeble longitudinal carina from between median tubercles to apex (sometimes absent); sparse vestiture of white and light brownish-yellow recumbent to subrecumbent setae; the latter colored setae more elongate than the former; the white setae on each side condensed into a sinuate line which in some specimens extends from the basal angle to near the apex, the lines gradually converging apically, majority of setae longer than those of elytra.

*Elytra:* Approximately one-fourth to one-third longer than wide; sides subparallel for approximately two-thirds, then gradually converging

to the apex; humeri obliquely rounded and prominent; basal border mesad of humeri emarginate; median elevation of interval 3 twice as long as posterior elevation and more prominent than either of the other two; broad costa of interval 5 interrupted twice, with the median elevation smaller and less prominent than the median one of interval 3; costa of interval 7 narrower than costae of intervals 3 and 5; serial punctures coarse and dense, closer together apically, giving surface a roughened appearance; vestiture of brownish-yellow and pure white, elongate, recumbent setae which are extremely sparse on the disc between and anterior to the median elevations of the third intervals; white setae condensed, in addition to the postmedian band, in a brief line at base of intervals 3 and 5, that of the latter being approximately half as long as that of the third; remainder of vestiture sparse, mostly of brownish-yellow setae.

*Ventral surface:* Metasternum in male grooved from meso- to metacoxae; groove absent in female. Abdominal sterna coarsely and densely punctate; punctures of sternum 2 sometimes smaller than those of 1; sternum 5 more finely and densely punctate than others, without tubercles; each puncture with a light reddish seta; setae along lateral margins broader, and white to reddish-brown in color; lateral setae in some specimens forming easily observed patches.

*Legs:* Proximal femoral tooth larger at base than prominent distal one; metaunci in both sexes non-dentate; legs with sparse covering (except for annulation) of brownish-yellow and whitish setae; metafemora distinctly annulated with pure white setae.

*Male genitalia:* (Figs. 45 and 72). Aedeagus not subrectangular, approximately twice as long as wide at base, distinctly longer than aedeagal struts; dorsal plate extending to base, neck of plate sometimes wider than in Fig. 45; apex of aedeagus bisinuate and forming a feeble process; ventral curvature angled approximately one-fourth from apex. Length .673-.687 mm., width at base .324-.363 mm., aedeagal struts .363-.406 mm.

*Type locality:* Texas.

*Lectotype*, hereby designated: Male, Museum of Comparative Zoology Type No. 5214-3, J. L. Leconte Collection (MCZ).

*Lectoparatype:* Female, M. C. Z. Type No. 5214-2, Southern States, J. L. Leconte Collection (MCZ).

*Distribution:* "Ranges from Michigan and District of Columbia to Georgia, Florida, and Texas," Blatchley and Leng (1916). The locality data from which the above range was calculated may in part refer to *buchanani* n. sp., but the records below indicate that this range is appli-



cable to *albicinctus* Lec. Above range extended north to Massachusetts, and west to Iowa and Kansas. Records from: Illinois, Iowa, Kansas, Massachusetts, Southern States (Georgia?), South Carolina, and Texas.

*Biology:* Pierce (1907a) reports a number of *albicinctus* Lec. beaten from *Clematis drummondii* and *Celtis* in a palmetto jungle at Santo Tomas, Texas. The same writer (1916) reports breeding this species from a gall on *Cornus candidissima* Marsh. The only available specimen record reveals its occurrence "on *Cornus*" at Dallas, Texas. As mentioned on page 53, however, the literature records given here may apply equally well to *buchanani* n. sp. When the specimen records for both species are considered in relation to the literature records, however, it appears probable that Pierce's first record has reference to *buchanani* n. sp. and his second to *albicinctus* Lec.

*Remarks:* *C. albicinctus* Lec. is closely related to both *buchanani* n. sp. and *iowensis* n. sp., and it is difficult to state to which of these *albicinctus* Lec. has the greatest affinity. By its elytral band *albicinctus* Lec. bears a closer resemblance to *buchanani* n. sp., but by the possession of a prominent mesoscutellum it is nearer to *iowensis* n. sp.

*C. albicinctus* Lec. has been confused with *nenuphar* (Hbst.) and has formerly had included with it all the specimens now designated as *buchanani* n. sp. The misidentification of *nenuphar* (Hbst.) as *albicinctus* Lec. has probably been due largely to superficial examination of the specimens. Both *buchanani* n. sp. and *albicinctus* Lec., however, have been grouped together as *albicinctus* Lec. by coleopterous workers. In the Leconte collection at the Museum of Comparative Zoology there are three cotypes of *albicinctus*, of which the first one in the series is *buchanani* n. sp. and the other two *albicinctus* Lec. Ordinarily the first specimen in a series of cotypes would be considered the type, and by this procedure the species now designated *buchanani* n. sp. would have taken the name *albicinctus* Lec. The first cotype, however, bears the locality label "Utah," and Leconte's original description states the distribution as "Southern States, Georgia to Texas," so that this specimen no doubt was received by him after the original description was published, and therefore cannot be considered as a type representative of the species described by Leconte (1876) as *albicinctus*. The second specimen is from "Southern States" and the third from Texas, so that the writer is quite certain that these are the specimens on which the original description of *albicinctus* Lec. was based. Consequently, the third specimen labelled *albicinctus* in the Leconte Collection, a male, 4.8 mm., MCZ Type No. 5214-3, is hereby designated the lectotype of *albicinctus* Leconte. The third specimen was selected instead of the second because of its definite locality.

*Conotrachelus iowensis* n. sp.

*Length:* 4.10-4.65 mm.

*Special characters:* Prothorax and elytra dark reddish and black; black on elytra chiefly confined to two prominent transverse bands, one medially, extending laterally to the median elevation of interval 5 on each side, the other on the apical declivity posterior to the apical elevations of intervals 3 and 5; prominence of color bands principally due to lack of vestiture in these areas.

*Head:* With dense semi-coarse punctures and with a moderately dense covering of mainly reddish-yellow setae but also with a few white ones, the latter chiefly between the eyes; vestiture sometimes rubbed off to a large degree; beak stout, with curvature slightly greater than that shown in Fig. 35; shorter than or equal to prothorax in length, equal in length in both sexes; trisulcate laterally between base and antennal insertion; upper and median sulci feeble and indistinct, the median one sometimes absent partway or replaced entirely by large punctures; upper sulcus sometimes distinct in male; lower sulcus distinct; male sometimes, when upper sulcus is distinct, with a faint broadly rounded carina on dorsal surface from base to distad of middle; dorsal aspect below antennal insertion with sparse to moderately dense elongate punctures; punctures denser along the sides and extending basally in two lateral series; sparse vestiture of reddish-yellow setae arising from sulci or from punctures replacing sulci, with a few white setae also present; antennae inserted approximately one-fourth to one-third from apex.

*Prothorax:* Sides feebly rounded or subparallel to approximately one-sixth before apex, then constricted; densely and coarsely punctate; punctures less evident along apical border; with six tubercles, one pair transversely at the middle, a second between the median pair and the base, and the third consisting of two widely separated tubercles, each located on the lateral slope behind the middle, the tubercles on each side of midline forming a triangle; median pair of tubercles always evident, but other pairs sometimes obsolete or sometimes with one tubercle of the pair feeble and obscure; tubercles rounded or flat on top; disc non-carinate or with a feeble longitudinal carina extending apically from between or posterior to median tubercles; sparse vestiture of reddish-yellow and white recumbent to subrecumbent setae; white setae on each side condensed in a sinuate line from inside of basal angle to before apex; lines approach apically but do not meet; the sinuate lines with short side branches, a median one between the median and posterior pairs of tubercles, and an oblique lateral branch apically; the majority of reddish-yellow setae approximately twice the length of white ones; some speci-

mens with vestiture, in part, rubbed off so above characteristics are not evident.

*Elytra:* Approximately three-fourths as wide as long; sides subparallel for approximately half, then gradually converging to the apex; humeri prominent and obliquely rounded; basal border emarginate before humeri; median elevation of interval 3 the longest and most prominent; interval 5 with a broad costa similarly interrupted as that of interval 3, but with elevations respectively less prominent, especially the median and posterior ones; posterior elevation of interval 5 as long as or longer than median one of interval 3; costa of interval 7 acute and complete except in one female where, on one side, it becomes so feeble laterad of the median elevation of interval 5 that it appears interrupted; serial punctures large and distinct on basal half but becoming smaller and less distinct apically; sparse vestiture of reddish-yellow and white recumbent setae; vestiture dense in a postmedian band in which white setae are chiefly condensed anteriorly in the area between intervals 3 and 5 (i.e., adjacent to and laterad of posterior half of median elevation of interval 3) with the reddish-yellow setae behind them; sometimes a few reddish-yellow setae intermixed with the anterior white ones; portion of band mesad of interval 3 with a mixture of reddish-yellow and white setae, or with white setae forming a narrow transverse band; white setae also condensed in a brief line at base of intervals 3 and 5; remainder of vestiture mostly reddish-yellow setae with scattered small patches of white ones; setae few in number or absent in area posterior to apical elevations of intervals 3 and 5 and in transverse area between median elevations of interval 5.

*Ventral surface:* Metasternum not grooved from meso- to metacoxa in either sex. Abdominal sterna 1 to 4 coarsely and densely punctate; punctures, especially of sterna 1 and 2, distinct and round, with the majority large; sterna 3 and 4 usually with punctures smaller than the majority of those of sterna 1 and 2; sternum 4 sometimes with finer punctation than 3; sternum 5 with punctures smaller than those of preceding sterna; punctures finer apically, usually without tubercles, but sometimes with a faint indication of a pair on the apical third; each puncture with a pale, amber seta; setae broader along the sides, usually white but sometimes reddish-yellow; sometimes faint lateral patches of vestiture on sterna 3 and 4.

*Legs:* Femoral teeth small but distinct, either equal in size or with proximal tooth largest; metaunci in both sexes non-dentate; femora and tibiae with sparse vestiture of reddish-yellow and white setae, except on apical half of metafemora, where vestiture is dense; abundance of white setae, increasing from profemora to mesofemora to metafemora, forming



on the latter a broad band at position of femoral teeth and a narrow band subapically.

*Male genitalia:* (Figs. 46 and 73). Aedeagus more than half as wide at base as long, and approximately twice as long as aedeagal struts; outer curvature near apex widened; apex faintly bisinuate and with a feeble process; dorsal plate sometimes extending nearer base than in Fig. 46. Length .562-.625 mm., width at base .324-.349 mm., aedeagal struts .262-.349 mm.

*Type locality:* Iowa City, Iowa.

*Holotype:* Male, United States National Museum Type No. 54308, May 17, 1917, L. L. Buchanan.

*Allotype:* Female, White Heath, Illinois, April 30, 1916 (ISNHS).

*Paratypes:* Iowa: Iowa City, May 17, 1917, L. L. Buchanan, ♀, (WPH); Clayton County, June 15, 1932, Barker, ♀, (HFS); Hardin County, June 20, 1934, H. C. Knutson, ♂, (HFS); Dickinson County, June 18, 1936, ♂, (IISC); Mt. Pleasant, April 14, 1930, H. Essex, ♂, (USNM).

*Distribution:* Range restricted to Iowa and Illinois.

*Biology:* No biological data are available for this species.

*Remarks:* This species is a close relative of *albicinctus* Lec., *buchanani* n. sp., and *nenuphar* (Hbst.). It has been confused with *nenuphar* (Hbst.) and labeled as such, but the two can easily be distinguished by the characters in the key. The exact relationship between these four species is difficult to determine, as the evaluation depends on the criterion used. If only the male genitalia are considered, *nenuphar* (Hbst.) appears isolated from the other three species; if the mesoscutellum is used as a criterion, *nenuphar* (Hbst.) and *buchanani* n. sp. fall in one group, and *albicinctus* Lec. and *iowensis* n. sp. in the other; and if their relationships are measured by the coloration of the postmedian band, *iowensis* n. sp. is linked to *nenuphar* (Hbst.), and *buchanani* n. sp. and *albicinctus* Lec. stand together. It appears that all four species recently arose from a common line of descent, but their relationships beyond that point are not clear.

Although this species has been found only in Iowa and Illinois, it may exist in some of the other states included in this study, since specimens of *nenuphar* (Hbst.) usually were not included in loans, and *iowensis* n. sp. has been misidentified as the plum curculio. However, in one hundred and forty specimens of *nenuphar* (Hbst.) in the Illinois State Natural History Survey collection, thirty-five from Massachusetts State College, thirty from the Bureau of Entomology and Plant Quarantine, Fort Valley, Georgia, an estimated five hundred from the Museum of

Comparative Zoology and United States National Museum, and specimens from Pennsylvania, New Hampshire, Montana, Florida, Kansas, and North Carolina, only two *iovensis* n. sp. have been found. This would seem to indicate that the species is not common.

In the United States National Museum collections, two small male specimens (3.0 and 3.45 mm.) resembling *iovensis* n. sp. were obtained. These specimens from Michigan and Ontario differ from *iovensis* n. sp. primarily in that the postmedian band lacks the prominent patch of white setae in the area between intervals 3 and 5 and that the beak is distinctly carinate and trisulcate. The aedeagi of these forms are similar to that of *iovensis* n. sp., excepting that the dorsal plate extends distinctly to the base and the inner curvatures (except apically) are parallel. Otherwise these specimens are the same as *iovensis* n. sp. They possibly are *iovensis* n. sp. or its closest relative. Tentatively, until further material is available, the two specimens have been referred to *iovensis* n. sp., although excluded from the type series.

*Conotrachelus retentus* (Say)

*Cryptorhynchus retentus* Say, 1831, Desc. N. A. Curc. New Harmony, Indiana, p. 27, in Writings of Thomas Say, ed. Leconte, 1859, p. 295.

*Conotrachelus retentus* (Say) Boheman, 1837, Schönh. Gen. Spec. Curc., IV, pt. 1, p. 442; Leconte and Horn, 1876, Rhynchophora N. A., Proc. Amer. Philos. Soc., XV, No. 96, p. 227; Blatchley and Leng, 1916, Rhynchophora N. E. Amer., p. 470.

*Length:* 5.70-7.25 mm.

*Special characters:* Prothorax and elytra brown to reddish; elytra with sparse to moderately dense vestiture of recumbent setae which are chiefly tan to brownish but sometimes white; numerous setae only about half the length of those on femora; specimens under low power with brownish or grayish cast; posterior elevation of interval 5 longer than median elevation of intervals 3 and 5; costal elevations presenting a somewhat even appearance.

*Head:* Coarsely, distinctly, and densely punctate; with a few scattered white and light tannish elongate setae, or with a sparse vestiture of similar colored setae; beak curved, longer than prothorax; beak slightly longer in female (2.2-2.4 mm.) than in male (1.6-1.9 mm.); male with beak more sharply curved apically and with three lateral sulci between base and antennal insertion; median sulcus frequently obscure, with area occupied by large punctures; lower sulcus broad, sometimes being divided into two sulci, with large punctures; dorsal surface usually with a broad rounded carina from base to distad of middle; the tip distad of antennal insertion with dense elongate punctures; female beak with three lateral punctate sulci between base and antennal insertion; median and

lower sulcus being distinct and reaching from base to distad of middle; upper sulcus faint, marked by rows of fine punctures, much shorter than other sulci, and usually not extending distad of middle; dorsal aspect not carinate; tip with fine sparse punctures distad of antennal insertion; punctures condensed laterally and basally in two lines, so that median portion is smooth proximad of the antennal insertion; both sexes with sparse vestiture of light tan and whitish setae proximad of antennal insertion; setae sometimes absent except for a few basally; antennae inserted at approximate apical third in female, and at apical fourth to fifth in male.

*Prothorax*: Apical constriction either abrupt or gradual; sides usually smoothly rounded from base to apical third, the outline sometimes presenting an even curve from base to apex, but occasionally being obtusely angulate on the basal two-thirds; outline sometimes varying on opposite sides; densely punctate, punctures shallow, usually distinct, and most evident laterally; disc with four indistinct tubercles (sometimes absent), with one pair transversely at the middle and the other between the median pair and the base; disc sometimes depressed between median and posterior tubercles on each side, the depressions accentuating the tubercles; a small, median callus (sometimes obscure) between median tubercles, with callus sometimes extending narrowly forward as a short carina or entirely replaced by a short median carina; sparse vestiture of white and tan recumbent to subrecumbent setae; setae sometimes absent on disc; whitish setae on each side condensed into a sinuate line extending from near basal angle to apex; lines approaching each other apically, in some specimens obscure and almost obliterated; tan setae more elongate than white ones.

*Mesoscutellum*: From dorsal aspect apex usually broadly rounded; from lateral aspect sloping basally, with slope occasionally steep or even abrupt.

*Elytra*: Approximately two-thirds as wide as long; sides subparallel for about one-half, then gradually converging to apex; humeri obliquely rounded and prominent; basal border emarginate before humeri; intervals 3, 5, 7, and 9 moderately and evenly costate; elevations of interval 3 distinct although not prominent; elevations sometimes subequal in length, or the median one longer than either of the other two; anterior elevation less evident than posterior and median ones; costa of interval 5 interrupted twice, but with posterior elevation always longest and subequal in prominence to median one; costa of interval 7 finer than those of intervals 3 and 5; serial punctures large and exceptionally distinct in some specimens; elytra with sparse to moderately dense vestiture of brownish-tan and white recumbent setae; majority of setae tan to brown; white setae mainly arising from punctures and condensed in small patches



on basal border between costae of intervals 3 and 5; sometimes also condensed between median and posterior elevations of interval 3; these latter white setae together with the lighter brownish-tan setae form the vague postmedian band.

*Ventral surface:* Metasternum in male feebly grooved from mesocoxa to metacoxa; groove absent in female. Abdomen shiny or dull; sterna finely punctate except for a coarsely punctured area along anterior border of sternum 1; punctures sparse on sterna 1 to 4 but dense on 5; sternum 5 without tubercles; punctures each with a fine, not easily seen, pale seta, usually most evident on fifth sternum where setae are longer; lateral setae broader and whitish and light tan in color, forming light, frequently obscure, patches.

*Legs:* Femoral teeth small and variable in size, being equal or with either proximal or distal tooth larger (one specimen with proximal tooth of mesofemora missing); legs with vestiture of white and light tan setae; metafemora annulated feebly; pro- and mesofemora without band.

*Male genitalia:* (Figs. 47 and 74). Aedeagus approximately one-half to one-third longer than wide at base and distinctly longer than aedeagal struts; outer curvature gradually widened apically; apex deeply bisinuate and with a narrow process; dorsal plate variable in width, indistinctly extending to base. Length .937-1.36 mm., width at base .536-.661 mm., aedeagal struts .550-.625 mm.

*Neotype locality:* Nashville, Tenn. Say's type locality: Mississippi.

*Neotype:* Male, June 23, 1893, H. Soltau (USNM).

*Neallotype:* Female, Riley County, Kansas, Popenoe (WPH).

*Neoparatypes:* ILLINOIS: Parker, June 8, 1913, ♂, (ISNHS); KANSAS: Topeka, 366, Popenoe, ♀, (USNM); Riley County, June 3, Kan. Ac. No. 1498, ♀, (WPH); MISSOURI: Columbia, Oct. 15, 1905, ♂, (HFS); Columbia, July 9, 1930, ♂, (UMo.); WEST VIRGINIA: French Creek, F. E. Brooks, Quaintance No. 21173, 2 ♂, 1 ♀, (USNM).

*Distribution:* Ranges from New Jersey and Pennsylvania south to North Carolina and Mississippi and west to Kansas and Missouri. Records from Arkansas, District of Columbia, Illinois, Kansas, Missouri, New Jersey, North Carolina, Ohio, Pennsylvania, Tennessee, Virginia, and West Virginia.

*Biology:* The life-history of this species has been studied by Brooks (1922). Specimens collected by Brooks at that time have been examined, and the species considered here as *retentus* (Say) is the same as the *retentus* (Say) of Brooks.

The only food plants known for this species are black walnut (*Juglans*

*nigra*) and butternut (*J. cinerea*), the latter being rarely attacked. Brooks (1922) consequently designated *retentus* (Say) the black-walnut curculio. The curculio overwinters in the adult stage, probably beneath duff on the surface of the ground. In the spring the beetles become active, attacking and feeding on leaves and tender shoots as soon as they appear. After a short time (late May and early June in W. Va.), the females begin oviposition in the young fruit, usually selecting nuts on which the female catkins have begun to wither. The eggs, when deposited in young nuts, are placed beneath the flap of skin within a crescent-shaped puncture eaten out of the side of the nut, while in half-grown nuts they are inserted in pin-prick punctures extending directly into the husk. The newly-hatched larva begins to feed from the side of the oviposition wound and, in young nuts, soon consumes the entire interior. In older nuts the feeding is done chiefly in the husk; rarely are larvae found burrowing in the tender shoots. Large nuts may contain two to three larvae, but smaller nuts generally support only one. Cannibalism occurs when several larvae are present. After the larva is about half-grown the infested nut drops to the ground, the larva continuing to feed while the nut dries and hardens.

When full grown the larva remains inactive inside the nut from 7 to 14 days before cutting its way out through the shell and entering the ground for pupation. The larvae usually leave the nuts in the morning and generally in cool weather. The pupal stage is passed 2 to 4 inches beneath the soil surface and lasts from 14 to 21 days, the adults appearing chiefly in late August. This new generation apparently feeds on the leaf petioles for a short time before going into hibernation for the winter.

Brooks (1922) states that in seasons when the walnut trees bear a light crop, a large percentage of the crop may become infested and drop, but in years of heavy fruitage the curculios only effect an unimportant thinning of the nuts. In one instance at French Creek, W. Va., Brooks collected 400 young nuts at random from four trees and found only 28% of this lot sound. In the 289 infested nuts there were 466 egg punctures. From Brooks' observation the black-walnut curculio appears more abundant and injurious in the latitude of Maryland and West Virginia than in the more northern range of the black walnut.

Parasites reared by Brooks from the larvae and pupae of the black-walnut curculio revealed three species of Diptera, *Chaetochlorops inquilina* Coq., *Cholomyia longipes* Fab., and *Fannia canicularis* L., and two species of Hymenoptera, *Triaspis curculionis* var. *rufus* (Riley) and *Thersilochus conotracheli* (Riley). The dipterous parasites were obtained in large numbers.

*Remarks:* This species was originally described by Thomas Say (1831), who characterized it as follows:

"*Cryptorhynchus retentus*. Body covered by very short, dense, prostrate hair; rostrum longer than the head and thorax; a little arcuated, punctured and on the sides lineated: thorax with two whitish undulated vittae: scutel orbicular: elytra with four elevated, acute, interrupted lines, between which are double series of impressed punctures: elevated lines obsolete on the depressed tip: thighs emarginate towards the tip and bidentate. Inhabits Mississippi. Length less than three-tenths of an inch."

Say's description does not sufficiently characterize this species to permit its positive identification. The mention of short hair (setae) and of the length are perhaps the most important points.

Leconte (1876) gave a more complete description, but had only one specimen from Kansas before him. Blatchley and Leng in 1916 again described *retentus* (Say), but their description is quite similar to that of Leconte.

The redescription by the author differs from those of Leconte and Blatchley and Leng chiefly in regard to the color of the vestiture, the size, and by the consideration of new characters. Some specimens have, under low power, the grayish cast mentioned by these writers, but under higher magnification the setae are found to be white, light tan, and brown. Other specimens have a distinct brownish hue under low magnification without a trace of gray. Both Leconte and Blatchley and Leng gave the length of *retentus* (Say) as 7 mm., but the majority of specimens on hand are below 7.0 mm., ranging from 5.6 to 6.6 mm. These variations in length at first gave an indication of size varieties, but because of the intergradations in length between the small and large specimens and because of similarity in genital structure all forms have been considered as one species. Several of these smaller specimens have a distinct brownish cast, but this appears to be due to their being freshly emerged. As the type of *retentus* (Say) has been destroyed, neotype and neoparatypes have been erected.

Both Leconte and Blatchley and Leng placed much stress on the median prothoracic callus as a means of separating *retentus* (Say) from *affinis* Boh. and the other species of Group I. This character on some specimens of *retentus* (Say) is distinct, but frequently it is obscure or else the callus extends forward as a short carina. Because of this variation and the fact that *affinis* Boh. and some of the other species in Group I may have a short carina which when feeble can easily be mistaken for a callus, this character is of little or no value. To replace it, the writer uses the sparse, fine punctation of the first four abdominal sterna to separate



*retentus* (Say), *affinis* Boh., and *hicoriae* n. sp. as a section from *aratus* (Germ.), *elegans* (Say), and others. For further separation of *retentus* (Say), *affinis* Boh., and *hicoriae* n. sp., see key, page 42.

*Conotrachelus affinis* Boheman

*Conotrachelus affinis* Boheman, 1837, Schönh. Gen. Spec. Curc., IV, pt. 1, p. 429; Dejean, 1835, 1837, Cat. Col., ed. 2, p. 297; ed. 3, p. 321, *n.n.*; Leconte and Horn, 1876, Rhynchophora N. A., Proc. Amer. Philos. Soc., XV, No. 96, p. 228; Blatchley and Leng, 1916, Rhynchophora N. Amer., p. 471; Mutchler and Weiss, 1925, Conotr. N. J., Circ. 87, Bur. Stat. and Insp., Dept. Agr., N. J., p. 20.

*Length:* 6.1-7.0 mm.

*Special characters:* Elytra with costal elevations not presenting an even appearance, with the median elevation of interval 3 usually the most prominent; females with a slightly curved beak that usually attains the abdomen or the posterior border of metasternum.

*Color:* Prothorax and elytra brown to dark reddish-brown, sometimes piceous.

*Head:* Semi-coarsely and densely punctate; sparse covering of brownish-yellow setae, basal setae finer; beak slightly curved in both sexes; in males curvature much sharper below antennal insertion; longer than prothorax, and much longer in female (2.6-3.5 mm.) than in male (1.9-2.0 mm.), reaching the first abdominal sternum in numerous specimens; with three lateral sulci between base and antennal insertion; sulci either distinct or faint, the median sulcus sometimes obliterated and succeeded by an irregular row of large punctures; sulci coarsely punctate; dorsal surface with an acute or broadly rounded carina extending from base to distad of middle, sometimes lacking in female; dorsal aspect distad of antennal insertion densely punctured (in female less densely, especially medially) with elongate punctures, frequently punctures appearing more like short sulci; sparse vestiture of light tan setae with a few scattered white ones; antennae inserted approximately one-third from apex in female, approximately one-fourth in male.

*Prothorax:* Sides rounded (sometimes feebly angulate) from base to approximately one-third before apex, then constricted; densely and coarsely punctate; with four faint tubercles on disc, one pair transversely at the middle, the other between median pair and base; median tubercles more prominent than posterior ones; disc on each side feebly (sometimes deeply) depressed between tubercles; with a median, longitudinal carina from anterior tubercles to apex; carina narrow and distinct or rounded and obscure, sometimes short and more of a callus than a carina; sparse vestiture of brown, light tan, and white elongate recumbent to subrecumbent setae; the white and light tan setae on each side chiefly condensed

in a sinuate line extending from near basal angle to before apex; lines approach apically but do not meet; brown setae more elongate than light tan and white ones.

*Mesoscutellum*: From dorsal aspect elongate or oval; from lateral aspect prominent (bump-like), either steeply inclined or abruptly declivent basally.

*Elytra*: Approximately two-thirds as wide as long; sides subparallel for more than half, then converging to apex; humeri prominent and obliquely rounded; basal border mesad of humeri emarginate; median elevation of interval 3 most prominent and larger than either anterior or posterior ones; costa of interval 5 either complete, or interrupted once or twice; when interrupted, median elevation most prominent; anterior elevation in one female almost obliterated; serial punctures large on basal half, finer behind the middle; sparse vestiture of brown, tan, and white elongate recumbent setae; tan and white setae condensed at postmedian band and at base of intervals 3 and 5 (the line of vestiture at base of interval 3 the most prominent); chiefly brownish setae scattered over remainder of elytra, rarely composing the central portion of the postmedian band, the band becoming less distinct when this type of seta is present.

*Ventral surface*: Metasternum usually not grooved from meso- to metacoxa in either sex; male sometimes with a faint indication of grooves. Abdominal sterna sparsely and finely punctured, except for a row of large punctures along anterior margin (occasionally in median area) of sternum 1; sternum 5 with denser punctation than sterna 1-4, without or with feeble tubercles; each puncture with a short pale seta; lateral setae broader and light tan, sometimes forming small patches on sterna 2-5.

*Legs*: Femoral teeth usually distinct on all femora, but occasionally either proximal or distal tooth is minute; sparsely covered with tan and white setae; setae condensed to form a band on metafemur at position of teeth (sometimes absent); occasionally a less distinct band subapically; pro- and mesofemora usually faintly or not annulated.

*Male genitalia*: (Figs. 48 and 75). Aedeagus approximately one-fourth longer than wide at base, and one-fourth longer than aedeagal struts; apex bisinuate and forming a broad process; dorsal plate variable in its extent; laterally, apical fourth of aedeagus distinctly but not abruptly curved ventrally. Length .775-.846 mm., width at base .548-.613 mm., aedeagal struts .625-.649 mm.

*Type locality*: "Boreal America."

*Type*: Boheman Collection; Stockholm Museum, Stockholm, Sweden.

*Plesiotypes*: ARKANSAS: Siloam Springs, July 20, 1908, Quaintance No. 5110, E. L. Jenne and S. W. Foster, ♂, ♀, (USNM); ILLINOIS: Galesburg, ♂, ♀, (ISNHS); MARYLAND: Glen Echo, June 24, 1922, J. R. Malloch, ♀ (USNM); VIRGINIA: Mt. Vernon, June 6, 1915, W. L. McAtee, ♂, (USNM); WEST VIRGINIA: French Creek, Sept. 12 and Sept. 15-16, 1920, Quaintance Nos. 21202 and 21207, reared from hickory nuts, F. E. Brooks, 4 ♂, 3 ♀, (USNM), ♂, ♀, (HFS).

*Distribution*: Ranges from New York (Buffalo) to Illinois south to Arkansas and Virginia. Recorded from Louisiana and Florida by Blatchley and Leng (1916), but these data may or may not apply to *C. hickoriae* n. sp. Records from: Arkansas, District of Columbia, Illinois, Maryland, New Jersey, New York, Pennsylvania, Virginia, West Virginia.

*Biology*: *C. affinis* Boh. and *hickoriae* n. sp. in the past have been considered as one species; the species considered here as *affinis* Boh., however, is the same as that called *affinis* Boh. by Brooks (1922) in his biological studies of the walnut and hickory curculios at French Creek, West Virginia. This synonymy is established by the fact that the accessional data of two series of curculios considered as *affinis* Boh. are: "*C. affinis* Boh., Host: Nuts of *Hicoria ovata*, numerous beetles reared from larvae attacking immature shagbark hickory nuts, nuts dropped and were collected from the ground" (French Creek, West Virginia, September, 1920, F. E. Brooks). In addition, the photograph of the adult curculio in Brook's report (Plate VI, a) is one of a female *affinis* Boh. This identification is based on the extreme length of the beak.

*C. affinis* Boh., known as the hickory-nut curculio, attacks the nuts of *Hicoria glabra*, *H. ovata*, and to some extent those of *H. alba* and *H. minima*. The adults come out of hibernation in late spring, the females commencing oviposition in late June (in W. Va.). As the curculios are especially active at nightfall, oviposition sometimes occurs after dark. Eggs are deposited in circular or crescent-shaped scars on the sides of half-grown nuts, the scars soon becoming brown or blackish and conspicuous. The resultant larvae feed singly in the nuts which drop to the ground 14 days after the larvae have begun to feed. This dropping of the green infested nuts about midsummer is the best indication of the presence of the hickory-nut curculio. In about two weeks the larvae leave the fallen nuts and pupate 1 to 2 inches below the surface of the soil, the adults issuing from the ground 30 days later (August to October). Soon after their issuance from the soil the adults go into hibernation until spring.

The larva of this curculio is attacked by several parasites. Brooks



(1922) reports two parasitic flies, *Cholomyia longipes* Fab. and *Myiophasia globosa* Towns., and two parasitic Hymenoptera, *Triaspis curculionis* var. *rufus* (Riley) and *Microgaster* sp., while Pierce (1908) records *Myiophasia aenea* Wied.

*Remarks:* *C. affinis* Boh. is closely related to both *retentus* (Say) and *hicoriae* n. sp., and confusion over their specific identities has been prevalent. As stated in the discussion of *retentus* (Say), the use of a prothoracic median callus to separate these species is of little value because of the difficulty of distinguishing between a callus and a short carina, and because of the variance occurring in the development of both these structures. The characters given in the key will best separate these species, the prominence and coloration of the postmedian elytral band usually being the most reliable external characters. Occasionally the band in *affinis* Boh. and *hicoriae* n. sp. tends to be obscure, and then a study of the other characters listed in the key is necessary.

*C. affinis* Boh. and *hicoriae* n. sp. appear to be more closely related to each other than either is to *retentus* (Say). The males of these species are distinguishable by the shape of the metaunci as listed in the key and by their aedeagi, but the females are very similar in appearance and difficult to separate. The character of the length of the antennal scape extending nearer the head capsule in *hicoriae* n. sp. than in *affinis* Boh. (Fig. 36) has been found to be the only reliable index to their specific identity. Usually the beak of *affinis* Boh. is extremely long in the female, reaching the abdomen, while that of *hicoriae* n. sp. only attains the mesocoxae. A few female specimens of *affinis* Boh., however, have beaks not attaining the abdomen, and a few specimens of *hicoriae* n. sp. exhibit beaks of the same length as these shorter "*affinis*" beaks, so this character cannot always be relied upon. If the beak of a female specimen definitely attains the abdomen, it is, without doubt, *affinis* Boh. If, on the other hand, the beak barely reaches the mesocoxae, the specimen is *hicoriae* n. sp.

The question as to whether the species here considered as *affinis* Boh. or the new species *hicoriae* n. sp. is the *affinis* of Boheman (1837) cannot be satisfactorily answered, since the type is in Stockholm, Sweden, and inaccessible at the present time. The original description and subsequent descriptions of Leconte and of Blatchley and Leng will fit both of these species. The decision to designate this species as *affinis* Boh. is based on Boheman's description of the size of *affinis* as "similar to that of *C. serpentinus* Boh." Specimens of *serpentinus* have a length of 6-7 mm., and the specimens of *affinis* Boh. described here have a similar length. On the other hand, *hicoriae* n. sp. varies from 4.4 to 7 mm. However, an examination of the type, if this is ever possible, may reverse the designations.

*Conotrachelus hicoriae* n. sp.

*Length:* 4.4-7.0 mm.

*Special characters:* Elytra with costal elevations not presenting an even appearance; median elevation of interval 3 the most prominent; females with a slightly curved beak that usually attains the mesosternum or the anterior portion of the metasternum.

*Color:* Prothorax and elytra reddish to dark reddish-brown, sometimes with small piceous or blackish areas.

*Head:* Semi-coarsely and densely punctate; sparse vestiture (sometimes moderately dense) of light tan setae; beak gradually curved to one-third before apex, curvature then more abrupt; abrupt apical curvature especially evident in male; beak sometimes straight for a short distance near middle; longer than prothorax; slightly longer in female (1.5-2.5 mm.) than in male (1.5-1.75 mm.); with three lateral sulci between base and antennal insertion; the lower sulcus distinct; median sulcus frequently indistinct and more of a row of large punctures than a sulcus; the upper sulcus also sometimes indistinct, especially apically where it evanesces into a row of large irregular punctures; male with a dorsal acute (sometimes rounded) carina from base to distad of middle; female with a rounded carina which is more distinct basally, sometimes evanescent before the middle; dorsal aspect distad of antennal insertion densely and elongately punctured in male, punctures frequently resembling small sulci because of their extreme length, those of female usually less dense and less elongate; sparse vestiture of mainly tan setae; antennae inserted approximately one-third before apex in female, one-fourth in male.

*Prothorax:* Sides rounded from base to less than one-third before apex (sometimes slightly angulate rather than rounded), then either feebly or abruptly constricted; densely and coarsely punctate; punctures more distinct laterally; disc with four tubercles, one pair transversely at the middle, the other between median pair and base; posterior tubercles less prominent than median ones, sometimes either or both pairs obsolete; a faint to distinct depression on each side between median and posterior tubercles; disc with a median, longitudinal carina (sometimes feeble) extending forward from between median pair of tubercles; carina sometimes reaching apex, sometimes evanescent before middle; sparse vestiture of light tan or yellowish, brownish-yellow, and white elongate recumbent to subrecumbent setae; yellowish and whitish setae on each side chiefly condensed in a sinuate line extending from just inside basal angle to apex; lines approach apically but do not meet; brownish-yellow setae usually more elongate than yellow or white setae.

*Mesoscutellum:* Prominent, from lateral aspect abruptly declivent basally.

*Elytra*: Nearly three-fourths as wide as long; sides subparallel for approximately half, then converging to apex; humeri prominent, obliquely rounded; base emarginate before humeri; the median elevation of interval 3 more prominent than anterior and posterior ones; interval 5 with costa interrupted once or twice; when singly interrupted break may be either anteriorly or posteriorly; occasionally the single anterior break is so feeble as to indicate a complete costa; serial punctures large, finer behind the middle; sparse vestiture of brown or yellow to white recumbent setae; whitish or light tan setae condensed in a distinct postmedian band and in a short line at base of intervals 3 and 5; both band and basal lines sometimes composed of yellowish setae or of a mixture of white and tan setae; setae of band usually distinctly denser than elsewhere; chiefly brownish-yellow or brown setae scattered over remainder of elytra, rarely included in the central portion of the postmedian band.

*Ventral surface*: Metasternum in both sexes without distinct grooves between the meso- and metacoxae. Abdominal sterna 1 to 4 sparsely, faintly, and finely punctate, except for a row of coarse punctures at basal border of sternum 1; sternum 5 more densely and usually more distinctly punctate than preceding sterna, punctation sometimes obscure, without or with faint tubercles, depressed laterally and sometimes medially; each puncture with a fine, pale reddish-brown seta which is sometimes difficult to detect, most evident on sternum 5; lateral setae broader and white, forming patches on sterna 2 to 5.

*Legs*: Femoral teeth varying from feeble to distinct; legs with sparse vestiture of white and pale tan setae; setae denser on metafemora and forming a distinct band at position of teeth, a less distinct subapical band sometimes present; pro- and mesofemora usually faintly or not at all annulated.

*Male genitalia*: (Figs. 49 and 76). Aedeagus approximately two-thirds to three-fourths as wide as long, distinctly longer than aedeagal struts; outer curvature usually with a slight indentation distad of middle; apex with a broad point but no process; dorsal plate variable in its extent; laterally, apical fifth of aedeagus is abruptly curved ventrally, sometimes more abrupt than in Fig. 76. Length .649-.673 mm., width at base .437-.512 mm., aedeagal struts .375-.524 mm.

*Type locality*: Bloomington, Illinois.

*Holotype*: Male, March 16, 1884, sifting leaves, Illinois State Natural History Survey.

*Allotype*: Female, United States National Museum Type No. 54309, French Creek, W. Va., Fred E. Brooks, Quaintance No. 7534 (USNM).

*Paratypes*: DISTRICT OF COLUMBIA, Hubbard and Schwarz, ♂,



(USNM); FLORIDA: Enterprise, May 23, C. V. Riley Coll., ♂, (HFS); Enterprise, Hubbard and Schwarz, ♀, (HFS); Monticello, June 15, 1913, bred specimens July 11 and 29, August 1, 1913, Quaintance No. 9074, J. B. Gill, 1 ♂, 2 ♀, (USNM); ILLINOIS: Monticello, August 1, 1908, ♂, (HFS); Northern Illinois, ♂, (ISNHS); KANSAS: Riley County, June 17, J. B. Norton, ♂, (WPH); Topeka, June 14 and 18, Popenoe, ♂, ♀, (USNM); LOUISIANA: Tallulah, ♀, (USNM); and Quaintance No. 4014, ♀, (USNM); NEW JERSEY: ♀, (USNM); SOUTH CAROLINA: No. Greenville Co., June 23, 1931, about 1500-2000 ft. elevation, F. Sherman, ♀, (USNM); TEXAS: Victoria, August 19, 1909, bred from pecan, McMillan, ♂, ♀, (USNM); VIRGINIA: Falls Church, July 16, 1917, Geo. M. Greene Coll., ♀, (HFS); WEST VIRGINIA: French Creek, Quaintance No. 7534, Fred E. Brooks, ♂, ♀, (USNM), ♀, (HFS); French Creek, F. E. Brooks, 2 ♀, (USNM); Morgantown, March 2, 1916, Kan. Acc. No. 3455, L. M. Peairs, 3 ♀, (WPH); West Virginia, F. H. Chittenden, ♀, (USNM).

*Distribution:* Ranges from New Jersey and Illinois south to Florida and Texas. Locality records from specimens not in type series: Arkansas (Siloam Springs); District of Columbia; Kansas (Topeka, Onaga); Louisiana (Loganport, New Iberia; Crowville, Baton Rouge); Maryland (Prince George County); New Jersey (Orange Mountain); Texas (Kerrville, Victoria); Virginia (Afton); West Virginia (French Creek).

*Biology:* This species, on the basis of specimen information, attacks the nuts of *Hicoria pecan*. J. D. Mitchell has bred specimens from green fallen pecan nuts at Victoria, Texas, and has also swept the adults from pecan trees. Data from two specimens bred by Mitchell reveal that the larvae left the green nuts about the first of August, entered the ground for pupation, with one adult issuing from the soil in about 18 days, the other in 30 days. C. E. Smith at Baton Rouge, Louisiana, records this curculio as definitely destructive to cultivated pecan. His note: "Bred from pecan, destroyed half the pecan nuts on several 11-year-old trees, larvae feed both on hull and kernel, July 26, 1934."

These data indicate that *hicoriae* n. sp. attacks *H. pecan* in much the same way as its near relative, *affinis* Boh., attacks *H. glabra*, *H. ovata*, *H. alba*, and *H. minima*. The information on the larval, pupal, and adult stages reveals that the life history and feeding habits of this species are also similar to those of *affinis* Boh. Although the available specimen data separate *affinis* Boh. and *hicoriae* n. sp. rather definitely in regard to their specific hosts, the host should not be used as a rigid criterion for the differentiation of the two species, since subsequent information may reveal similar hosts for both species. *C. hicoriae* n. sp. has been found on

peach at Siloam Springs, Arkansas, by S. W. Foster and has been collected at lights in the District of Columbia by J. R. Greeley.

*Remarks:* The taxonomic and phylogenetic discussion of *C. hicoriae* n. sp. is given under *C. affinis* Boh., page 68.

*Conotrachelus falli* Blatchley

*Conotrachelus falli* Blatchley, 1916, Blatchley and Leng, Rhynchophora N. E. Amer., p. 471.

*Length:* 4.8-5.8 mm.

*Special characters:* Prothorax with very dense, coarse, reticulate punctures, and with very sparse vestiture; proximal femoral tooth distinctly larger than distal one.

*Color:* Prothorax darker than elytra, which is reddish and black, the black chiefly present in a median transverse band.

*Head:* Coarsely and densely punctate; sparse vestiture of brownish-yellow, brown, and white setae which are finer basally; beak slightly curved to near antennal insertion, then curvature usually more distinct; beak longer than prothorax, slightly longer in female than in male; with three distinct lateral sulci between antennal insertion and base; median sulcus less distinct than other two; dorsal aspect with rounded carina from base to distad of middle; area distad of carina in female smooth and with dense, elongate, fine punctures to before the apex; area in male rough, lacking fine, dense punctation but with larger, more elongate punctures resembling small sulci; sparse vestiture of brownish-yellow and white setae from base to above antennal insertion; antennae inserted approximately one-third from apex in female, approximately one-fourth in male.

*Prothorax:* Sides slightly rounded or subparallel from base to before apex, then constricted; reticulate punctures large and deep, sometimes confluent apically; with a median, longitudinal, feebly tortuose carina, sometimes extending from basal sixth to near apex, sometimes present only on median third; length of carina variable; with very sparse vestiture of chiefly brownish subrecumbent to suberect fine setae, one to each puncture; also a few broader white and light tan (occasionally reddish-yellow) setae present along basal border medially and near basal angles.

*Mesoscutellum:* From lateral aspect abruptly declivent basally.

*Elytra:* Almost three-fourths as wide as long; sides subparallel for approximately one-half, then gradually converging apically, sometimes convergence beginning just behind the humerus; humeri obliquely rounded and not or feebly prominent; basal border mesad of humeri sometimes feebly emarginate; intervals 3, 5, 7, and 9 costate; costae

usually acute and complete, the costa of interval 3 sometimes interrupted behind the middle; serial punctures large and quadrate, smaller apically; sparse vestiture of brown, tan, and white recumbent setae, the white and light-tan setae sometimes forming a usually vague postmedian band; white setae scattered over elytra and frequently forming small patches, condensed in a prominent brief line at base of interval 3.

*Ventral surface:* Metasternum not grooved from meso- to metacoxa in either sex. Abdominal sterna coarsely and densely punctate; punctures of sternum 2 slightly smaller than those of 1; sternum 5 with finer punctures apically and without tubercles, each puncture with a fine pale amber seta; lateral setae broader and yellow or white in color.

*Legs:* Femoral teeth frequently incompletely separated; metaunci in both sexes not dentate; legs feebly annulated with white or light tan setae, the annulation progressively less distinct from meta- to profemora.

*Male genitalia:* (Figs. 50 and 77). Aedeagus slightly less than twice as long as wide, distinctly longer than aedeagal struts; prephallotremic area small; apex bisinuate with a slight process; dorsal plate faintly extended to base; laterally, ventral curvature abruptly angled one-seventh before apex; dorsal curvature also angled but before apical seventh. Length .800-.824 mm., width at base .425-.461 mm., aedeagal struts .500 mm.

*Type locality:* Porter County, Indiana.

*Type:* W. S. Blatchley Collection, June 5 (PU).

*Distribution:* Rare. Recorded only from Indiana, Virginia (Vienna, Nelson County), and Louisiana (Covington).

*Biology:* No records are available.

*Remarks:* *C. falli* Blatch. shows no close affinities to other species of Group I and, by virtue of its usually complete elytral costae, stands alone in the group. The form and size of the aedeagus, however, resembles that found in other species of the group, excepting *nivosus* Lec. and *seniculus* Lec.; and it appears that *falli* Blatch. is more closely linked to the other species in Group I than is the case with either of these two species.

#### *Conotrachelus nivosus* Leconte

*Conotrachelus nivosus* Leconte, 1876, Rhynchophora N. A., Proc. Amer. Philos. Soc., XV, No. 96, p. 229.

*Conotrachelus plagiatus* Leconte, 1876, loc. cit., p. 233.

*Length:* 3.5-5.4 mm.

*Special characters:* Prothorax with dense, coarse, reticulate punctures, and with a dense brown and white vestiture; abdominal sterna 1-4 with scattered large punctures.



*Color:* Prothorax and elytra piceous.

*Head:* Densely but not coarsely punctate; punctures obscured for the most part by dense vestiture of brown, brownish-yellow, and white scales or scale-like setae, all of which converge toward a point distad of the middle; beak stout, strongly curved; shorter than prothorax, length equal in both sexes; from dorsal aspect wider at apical end than at base; trisulcate laterally between base and antennal insertion; the lower sulcus distinct, the median one faint or entirely lacking, the upper one varying from distinct to feeble; dorsal aspect with an obscure broad carina from base to distad of middle (usually more distinct and acute in male); carina sometimes entirely lacking; dorsal area distad of middle or distad of carina, when present, roughly punctate with fine to coarse punctures, density variable; with a dense or sparse vestiture chiefly of light brownish-yellow scales or scale-like setae, sometimes with a few scattered white ones also present; antennae inserted approximately one-third before apex.

*Prothorax:* Sides subparallel but gradually widening from base to one-third before apex, then constricted; sides sometimes rounded to apical constriction; reticulate punctures shallower on apical dorsal border; non-carinate; dense vestiture of oblong, dark brownish, brownish-yellow, and white recumbent to erect scales; brown and brownish-yellow recumbent to suberect scale-like setae intermixed over surface; white scale-like setae on each side condensed in an irregular oblique line from basal angle to middle, line sometimes dividing apically into irregular anterior and median branches, the median branches from each side uniting at the center; setae dense around borders of punctures, each of which contains one erect seta arising near its center; when bordering setae are subrecumbent or suberect and not overlapping the punctures, the latter are distinct amid the dense vestiture, most evident on median basal half; vestiture less dense on the sides.

*Mesoscutellum:* From lateral aspect abruptly declivent basally.

*Elytra:* Approximately three-fourths as wide as long; sides subparallel to approximately one-third before apex, then abruptly converging; humeri rounded and sometimes prominent; basal border feebly emarginate before humeri; intervals 3, 5, 7, and 9 at the most feebly costate; a basal elevation on interval 3 and slight subapical elevations on intervals 3, 5, 7, and 9; interval 3 also with a slight rise before the middle; serial punctures large; dense vestiture of dark brown, brownish-yellow, pale gray, and white scales or scale-like recumbent setae; whitish and pale gray scale-like setae usually covering most of basal two-thirds, except below and anterior to the humerus, where there is a small brown spot, and medially where dark brown setae cover the transverse basal area between intervals 4 and extend posteriorly one-sixth of the elytral

length; sometimes median brown area extends half the length of the elytra between intervals 3, with white and pale gray scale-like setae scattered among the brown ones; interval 1 with vestiture mainly of light brown scale-like setae; pale gray setae chiefly in a broad area posterior to humeri; apical third with dark-brown, brownish-yellow, and white scale-like setae; darker setae predominant, giving area brownish aspect.

*Ventral surface:* Metasternum not grooved from meso- to metacoxa in either sex; metapleura and sides of metasternum densely clothed with whitish scale-like setae. Abdominal sterna 1-4 shiny and sparsely punctate, with large round punctures interspersed with denser fine ones; sterna 3 and 4 with the large punctures usually alined on apical border; sternum 5 densely punctate, punctures coarse basally, becoming finer toward the apex, without tubercles; each puncture, whether coarse or fine, with a brownish-yellow, pale gray, or white seta or scale-like seta; setae scattered over sterna 1 and 2, and chiefly condensed along the sides on 3 and 4; sternum 5 with a patch of vestiture on each side of middle along basal border.

*Legs:* Distal femoral tooth frequently minute and indistinct; metaunci non-dentate in both sexes; legs usually densely covered with brown, brownish-yellow, and white scales or scale-like setae; meso- and meta-femora annulated with white scales apically, profemora feebly so.

*Male genitalia:* (Figs. 55 and 82). Aedeagus elongate, approximately two and one-half times as long as wide, and approximately three and one-half times as long as the aedeagal struts; outer curvature widened apically and indented at apical fifth; apex with a distinct process; dorsal plate obliterated except for a small triangular piece at base; distinct sclerotized plate of transfer apparatus extending beyond apex of lateral plates at middle; heavy semicircular membrane lining apical rim of pre-phallotremic area. Length .937-1.00 mm., width at base .351-.399 mm., aedeagal struts .226-.262 mm.

*Type locality:* Colorado.

*Type:* Museum of Comparative Zoology Type No. 5213, J. L. Leconte Collection (MCZ).

*Distribution:* Ranges from Indiana and Illinois to Colorado and Montana, south to Oklahoma, Texas, and New Mexico. Records from: Colorado, Illinois, Iowa, Kansas, Montana, Nebraska, New Mexico, Oklahoma, South Dakota, Texas, Wisconsin, and Wyoming.

*Biology:* This species has been taken on Russian thistle, *Salsola pestifer*, near N. Lovington, New Mexico, and N. L. Town has frequently collected it in the sandhills of Riley County, Kansas. No further biological information is available.

*Remarks:* This species belongs in Group I by virtue of its two-toothed femora, but the distal tooth is minute and can easily be overlooked. Leconte (1876, p. 233) overlooked this denticle and erected *C. plagiatius* n. sp., but in the appendix of the same publication (p. 419) designated it a synonym of *nivosus* Lec.

Leconte in his original description of *nivosus* states that the prothorax is longer than wide. Measurements of the type, however, refute this statement, the prothorax being wider (1.65 mm.) than long (1.3 mm.).

Although placed in Group I, because of its two-toothed femora, this species shows little relationship to the other species of the group with the possible exception of *seniculus* Lec. Leconte (p. 225) terms it a transition species to his Group II (B. & L. Group IV and the writer's Group III) because of the obsolete, distal femoral tooth. *C. nivosus* Lec. does show affinities with *leucophaeatus* Fahr. on the basis of vestiture, but since it lacks the median, longitudinal furrow of the prothorax the two cannot be considered as closely related. It appears to be more a case of parallelism where similar types of vestiture have developed in distantly related groups.

#### *Conotrachelus seniculus* Leconte

*Conotrachelus seniculus* Leconte, 1876, Rhynchophora N. A., Proc. Amer. Philos. Soc., XV, No. 96, p. 227; Dejean, 1837, Cat. Col., ed. 3, p. 321, *n.n.*; Blatchley and Leng, 1916, Rhynchophora N. E. Amer., p. 472; Mutchler and Weiss, 1925, Conotr. N. J., Circ. 87, Bur. Stat. and Insp., Dept. Agr., N. J., p. 20.

*Length:* 3.7-5.0 mm.

*Special characters:* Longitudinal carina of prothorax extending from base or just before base to apex; abdominal sternum 1, excepting basal row of coarse punctures, with finer and less dense punctures than sterna 3 and 4; proximal femoral tooth much larger than distal one.

*Color:* Prothorax and elytra reddish to piceous.

*Head:* Semi-coarsely and densely punctate; sparse to moderately dense covering of brownish-yellow and tan setae; beak short, stout, and strongly curved; either shorter or but slightly longer than prothorax, equal in length in both sexes; trisulcate from above antennal insertion to base; lower sulcus broad and distinct; upper and median sulci less distinct, being obscure basally and sometimes also apically, especially the median sulcus; dorsal aspect acutely carinate; carina extending from base to above antennal insertion or ending before the middle, usually longest in male; dorsal aspect distad of carina with dense, elongate punctures which in some cases coalesce to form short sulci; vestiture of light and dark tannish setae in sulci, those arising in upper sulcus usually denser, especially basally; antennae inserted approximately one-third from tip of beak.



*Prothorax*: Sides subparallel or slightly rounded to one-fourth before apex, then suddenly constricted; densely, coarsely, and unevenly punctate; disc, in addition to depression just behind middle, with an elongate shallow depression on each side between carina and oblique line of vestiture anterior to middle; moderately dense vestiture of tan and whitish setae, tan setae usually predominating, the majority recumbent and short, some elongate and subrecumbent or suberect; lighter tan, sometimes whitish, setae condensed on each side in an oblique line extending from basal angle to apex; lines meeting apically.

*Mesoscutellum*: From lateral aspect abruptly declivent basally.

*Elytra*: Approximately two-thirds as wide as long; sides subparallel for more than half, then gradually converging to the apex; basal border feebly emarginate before the humeri, which are obliquely rounded and not prominent; intervals 3, 5, 7, and 9 feebly to moderately costate; costa of interval 5 complete, or interrupted once or twice, usually complete or with feeble indication of an interruption anteriorly; costa of interval 7 sometimes extremely feeble; that of interval 9 sometimes extending onto humerus basally; serial punctures coarse, less distinct distad of middle; with a moderate to dense covering of brownish and tannish or pale tannish, sometimes whitish, oblong or elongate recumbent setae, the lighter tan and sometimes the whitish ones condensed in a usually faint postmedian band; color range of setae varying from dark brown to white; each interval with a row of white or brownish suberect setae; similar setae arising from serial punctures; setae when brown not very evident, sometimes visible only on a small area; other times present over most of elytra, their prominence variable; setae when white conspicuous; whitish setae sometimes abundant, the entire vestiture then lighter in color and the postmedian band distinct.

*Ventral surface*: Metasternum not grooved from meso- to metacoxa in either sex. Abdominal sternum 2 with punctures denser and coarser on basal two-thirds than those of sternum 1; apical third of sternum 2 with fewer punctures; sternum 5 without tubercles and densely punctate, punctures along basal border resembling those of preceding sternum, punctures finer apically; each puncture with an elongate seta; lateral setae usually broader and white and tan in color, those in central areas of sterna usually less evident, pale amber to whitish; apical borders of sterna 3 and 4 usually bearing a few conspicuous suberect setae, the latter sometimes present on sternum 2.

*Legs*: Metaunci not dentate in either sex; femora with setae denser on apical third and lighter in color than those basally, especially on meta-femora, where the apical band is usually most evident.

*Male genitalia:* (Figs. 56 and 83). Aedeagus elongate, three times as long as wide at base, and eight and one-half times as long as the aedeagal struts, gradually widened apically; apex without a process; dorsal plate elongate; sclerotized plate of transfer apparatus projecting beyond apex of dorsal plate; apical end of prephallotremic area lined with a heavy membrane which extends basally at the middle. Length 1.11-1.18 mm., width at base .312-.350 mm., aedeagal struts .125-.137 mm.

*Type locality:* "Middle States."

*Lectotype*, hereby designated: Museum of Comparative Zoology Type No. 5223-2, J. L. Leconte Collection (MCZ).

*Lectoparatypes:* Museum of Comparative Zoology Type Nos. 5223-3 and 5223-4; "Western States," J. L. Leconte Collection (MCZ); Museum of Comparative Zoology Type No. 5223-5, Texas; J. L. Leconte Collection (MCZ).

*Distribution:* Ranges from Quebec and New England to Michigan and Kansas south to Mississippi and Florida," Blatchley and Leng (1916). Extended to Arizona by Leng (1920). Range herein further expanded westward to California and to Nebraska. This is the most widely spread species in the genus. One specimen has the locality label "Tacoma, Washington," but as there are no further data on the label, and since no *Conotrachelus* has ever been reported from that region (Northern California, Oregon, and Washington), the author feels that this record should be confirmed before being accepted. Although probably over five hundred specimens have been examined, none have been found occurring north of New Jersey to substantiate Blatchley and Leng's (1916) statement of its occurrence in Quebec and New England. Possibly these records of northern distribution are the result of misidentifications, since in the past *seniculus* Lec. has been confused with *elegans* (Say). Mr. C. A. Frost, who has collected extensively in Massachusetts, has informed the writer that he knows of no authentic record of this species from New England. Records from: Alabama, Arizona, Arkansas, California, Delaware, District of Columbia, Florida, Illinois, Indiana, Iowa, Kansas, Kentucky, Louisiana, Maryland, Mississippi, Missouri, Nebraska, New Jersey, North Carolina, Ohio, Oklahoma, Pennsylvania, South Carolina, Tennessee, Texas, Virginia.

*Biology:* Chittenden (1898) first noticed the work of *C. seniculus* Lec. on the roots of *Amaranthus*, but unfortunately misidentified the species as *elegans* (Say). In 1924 the same writer, however, corrected this error of identification. At this time he gave *seniculus* Lec. the common name of "Amaranth curculio."

The following specimen data substantiate Chittenden's records that

Amaranth is the common host: "In crown of *Amaranthus*" (Bentonville, Ark., A. J. Ackermann); "feeding on roots of *Amaranthus* sp." (Baton Rouge, La., C. E. Smith and N. Allen); "host *Amaranthus*" (Thornville, Ohio, C. R. Neiswander); "feeding in roots of *Amaranthus hybridus* (green pigweed)" (Falls Church, Va., R. A. St. George); and "collected on pigweed" (Moorehaven, Fla., J. E. Graf and K. E. Bragdon).

Chittenden (1924) found a heavy infestation of larvae on the roots of cultivated amaranth in the first week in September at Washington, D. C. Three weeks later the majority of the insects were in the pupal stage, and on September 28 the first adult emerged. Chittenden found that the larvae were most numerous on mature plants, frequently injuring the stems as well as the roots. In 1898 the same writer reared adults from the roots of *A. retroflexus* as early as August 18 in Washington, D. C. *C. seniculus* Lec. has also been collected on bean stalks, alfalfa, grass, and in cotton bolls, and has been observed feeding on spinach. No information is available on the activities of this species in the winter, spring, and early summer.

From specimen records the writer believes that this species is attracted to lights more readily than any of the other *Conotrachelus* considered in this report. Records show that *seniculus* Lec. has been collected "at lights" or "in light traps": Tempe and Phoenix, Arizona; District of Columbia; Homestead, Florida; Elizabethtown, Illinois; Douglas County, Kansas; Gueydon, Louisiana; Plummer's Island, Maryland; Charleston, Missouri; Crowley, North Carolina; Durant, Oklahoma; Nashville, Tennessee; Plano and Victoria, Texas; Falls Church and Maywood, Virginia; Webster Springs, West Virginia. This species has also been taken in Japanese Beetle traps at St. Louis, Missouri.

*Remarks:* *C. seniculus* Lec. is easily distinguished from the other species in Group I by the distinct longitudinal carina and discal depressions of the prothorax. Unfortunately, it has been confused with *elegans* (Say), which not only lacks the prominent prothoracic carina but has an abdominal punctation quite distinct from that of *seniculus* Lec. Specimens of *seniculus* Lec. usually are dirty, and the prothoracic sculpture consequently obscure, and possibly this is the reason for its misidentification as *elegans* (Say). Frequently specimens of *posticatus* Boh. are also labelled *seniculus* Lec., but this is due to a lack of examination, since *posticatus* Boh. has only one femoral tooth and belongs to Group II.

In the Leconte Collection at Cambridge, the first cotype of *seniculus*, Type No. 5223-1, "Middle States," is a specimen of *aratus* (Germ.) and consequently does not fit the original description of *seniculus* Lec. Therefore, the second specimen of the cotype series has been designated as the lectotype. Leconte did not designate types, and those in the Leconte Col-



lection were indicated by Henshaw. This fact releases Leconte from the inaccuracies sometimes found in the type specimens of his collection.

On the basis of the male genitalia, *seniculus* Lec. and *nivosus* Lec. are definitely isolated from the other species of Group I. In both, the transfer apparatus is heavily sclerotized and projecting into the prephallotremic area, and in both the dorsal plate of the aedeagus is of unusual form. In *seniculus* Lec. (Fig. 56) this plate is elongate and directly connected to the lateral plates along its entire length, while in *nivosus* Lec. (Fig. 55) it is lacking except for a small triangular basal piece. In all the other species of Group I, the dorsal plate is separated from the lateral plates apically by membranous areas, and the transfer apparatus does not project into the prephallotremic area.

### *Conotrachelus elegans* (Say)

*Cryptorhynchus elegans* Say, 1831, Desc. N. A. Curc. New Harmony, Indiana, p. 18, in Writings of Thomas Say, ed. Leconte, 1859, p. 283.

*Conotrachelus elegans* (Say) Boheman, 1837, Schönh. Gen. Spec. Curc., IV, pt. 1, p. 428; Leconte and Horn, 1876, Rhynchophora N. A., Proc. Amer. Philos. Soc., XV, No. 96, p. 228; Blatchley and Leng, 1916, Rhynchophora N. E. Amer., p. 472; Mutchler and Weiss, 1925, Conotr. N. J., Circ. 87, Bur. Stat. and Insp., Dept. Agr., N. J., p. 20.

*Length:* 3.8-5.1 mm.

*Special characters:* Abdominal sterna 1-4 coarsely and densely punctate; interpunctate areas of sterna 1 and 2 usually not larger than the diameters of the punctures.

*Color:* Prothorax and elytra reddish and black, black of elytra frequently centered in basal discal half, the red apically; the apex sometimes black; derm beneath postmedian band usually reddish; discal area not always distinct.

*Head:* With dense semi-coarse punctures; sparsely covered with tan and white setae; beak in male but slightly longer than prothorax; curvature moderate until near apex, then more abrupt; beak in female elongate (Fig. 39), distinctly longer than prothorax; curvature slight but even from base to tip, longer (1.55-1.97 mm.) than in male (1.20-1.45 mm.); beak in both sexes with three lateral sulci from base to distad of middle, sulci varying in distinctness; upper and median sulci sometimes shallow and ill-defined; dorsal aspect broadly to acutely carinate from base to distad of middle; surface distad of carina with dense elongate punctures; punctures more distinct in female and sometimes less dense; with sparse tan and white setae arising from lateral sulci; antennae inserted approximately one-third from apical tip in female, approximately one-fourth in male.

*Prothorax:* Sides gradually rounded from base to near apex, then

constricted; sides sometimes subparallel for a short distance; with dense, coarse punctures, the punctures less evident apically and sometimes confluent; disc usually without tubercles, but occasionally two feeble pairs present, one transversely at middle, the other between median pair and base; disc sometimes depressed on posterior two-thirds; if tubercles are evident, depressed areas are between the median and posterior pairs; usually non-carinate but occasionally with a vague, feeble ridge from middle to before base; sparse vestiture of light reddish-yellow to white elongate recumbent to subrecumbent setae; light-colored setae condensed on each side into an oblique line from just inside basal angle to near apex; lines approach apically but do not meet, sometimes obscure.

*Mesoscutellum*: Prominent, from lateral aspect abruptly declivent basally.

*Elytra*: Between two-thirds and three-fourths as wide as long; sides subparallel for over half, then gradually converging to apex; humeri rounded, not prominent; basal border only feebly emarginate before humeri; intervals 3, 5, 7, 8, and 9 feebly to moderately costate; median elevation of interval 3 usually longer and more prominent than the others; anterior interruption sometimes so slight as to indicate completeness basally; costa rarely definitely complete anteriorly; costa of interval 5 either complete or interrupted posteriorly, with occasionally a faint indication of anterior interruption; serial punctures coarse on basal half of elytra, deeper and closer together anteriorly; sparse vestiture of pale white, white, reddish-yellow, and tan recumbent setae; lighter tan and white setae condensed in a definite postmedian band and sometimes in a short line at base of intervals 3 and 5.

*Ventral surface*: Metasternum in male grooved from meso- to metacoxa; groove absent in female. Abdominal sterna 1 and 2 usually with punctures as dense as in Fig. 33, but sometimes less dense; sterna 3 and 4 sometimes with punctures smaller than those of 1 and 2; sternum 5 more finely punctate apically than other sterna, without tubercles or with faint broad protuberances; each puncture with a fine, pale reddish seta; lateral setae broader, tan and white, sometimes forming small patches along the sides on sterna 2 to 5.

*Legs*: Femoral teeth usually distinct, sometimes feeble; either tooth may be larger; in males prounci sometimes feebly dentate, metaunci sometimes tridentate (Fig. 25); legs with sparse vestiture of pale white, white, or tannish setae, sometimes dense on apical third of femora, especially metafemora.

*Male genitalia*: (Figs. 51 and 78). Aedeagus nearly twice as long as wide and distinctly longer than aedeagal struts; sides gradually tapering to apex, which has only extremely feeble sinuations; laterally, the ven-

tral and dorsal curvatures gradually approaching apically, the aedeagal cavity being shallow. Length .687-.750 mm., width at base .355-.406 mm., aedeagal struts .343-.450 mm.

*Neotype locality*: Jefferson Barracks, Missouri. Say's type localities: New Jersey and Florida.

*Neotype*: Male (USNM).

*Neallotype*: Female, Carbondale, Illinois; May 18, 1910, on hickory (ISNHS).

*Neoparatypes*: ILLINOIS: Algonquin, Nason, ♂, ♀, (DEUI); Northern Illinois, 3 ♀, (ISNHS), ♂, 2 ♀, (HFS); Villa Ridge, June 4, 1892, Ac. Nos. 18657, 18658, McElfresh, ♂, ♀, (ISNHS); Dubois, May 10, 1904, Ac. No. 34664, Taylor, jarred from plum, ♂, (ISNHS); Cedar Lake, June 20, 1892, Ac. No. 18356, Shiga, and Hart, ♀, (ISNHS); Oakwood, May 8, 1927, Frison, ♀, (ISNHS); IOWA: Mt. Pleasant, June 17, 1926, ♂, (WPH); KANSAS: Riley County, Popenoe, ♀, (USNM); MARYLAND: Plummer's Island, May 24, 1914, L. L. Buchanan, ♀, (USNM); MICHIGAN: Detroit, Hubbard and Schwarz, ♂, (USNM); NEW JERSEY: Booton, June 11 and 16, 1901, Geo. M. Greene Coll., ♂, ♀, (USNM); New Jersey, Chittenden Coll., ♀, (HFS); Clifton, August 8, 1906, R. Godfrey, Geo. M. Greene, ♂, (USNM); New Foundland, 5-30, Ed. A. Bischoff Coll., ♀, (USNM); Orange Mt., Ed. A. Bischoff Coll., ♀, (USNM); and New Jersey, Chicago Field Museum Coll., ♀, (HFS); NORTH CAROLINA: Raleigh, May 17, 1940, pecan 255, R. C. Barnes, ♂, (HFS); TEXAS: ♀, (WPH); Victoria, June 7, 1910, Hunter No. 3789, J. D. Mitchell, ♀, (HFS); VIRGINIA: Falls Church, July 4, 1919, L. L. Buchanan, ♂, (USNM); Nelson County, August 2, 1927, W. Robinson, ♀, (USNM); WEST VIRGINIA: French Creek, F. E. Brooks, ♂, ♀, (WPH).

*Distribution*: "Ranges from Massachusetts to Michigan and Missouri, south to Florida." Blatchley and Leng (1916). Range extended north to Ontario, west to Kansas and Nebraska, and southwest to Texas. Records from: Alabama, Illinois, Indiana, Iowa, Kansas, Louisiana, Maryland, Massachusetts, Michigan, Missouri, Nebraska, New Jersey, New York, North Carolina, Ohio, Ontario (Toronto), Pennsylvania, South Carolina, Tennessee, Texas, Virginia and West Virginia.

*Biology*: The biological status of *C. elegans* (Say) has been uncertain in the past because of misidentifications. As discussed under *C. seniculus* Lec., Chittenden (1898) mistook that species for *elegans* (Say). His subsequent correction (1924) has cleared up much, but unfortunately not all, of the confusion concerning the host plants of *elegans* (Say).

Say (1831) originally collected *elegans* (Say) on *Pinus rigida*, while Hamilton (1895) reports it as common on hickory, the larvae living on



the leaves. Ulke (1902) also reports this species on hickory. Pierce (1907a), quoting Packard, states that *elegans* (Say) lays its eggs in the partly rolled up leaves of pignut hickory (*Hicoria glabra*) in late May, and during oviposition cuts off the leaves causing them to hang down, wither, and turn black. Hunter and Pierce (1912) list *elegans* (Say) as the pecan gall weevil, attacking the galls and nuts of hickory, and Pierce (1916) states: "*C. elegans* Boheman is a very important enemy of nuts. In Texas the first generation breed in the petioles and new shoots of hickory (*H. alba*). Later individuals are found commonly in the leaf galls of *Phylloxera devastatrix* on pecan (*H. pecan*), and still later the species is bred from nuts of various species of *Hicoria*." Champlain and Knull (1921) at Westbury, N. Y., record the adults as damaging the stems of hickory in feeding and in making egg punctures, and the larvae as working in the shoots and leaf stems, causing them to wilt and fall. Mutchler and Weiss (1925) term *elegans* (Say) the "pig-nut leaf curculio" and state that it has been wrongly recorded as attacking pecan.

The specimen records on *elegans* (Say) are as follows: "bred from pecan leaf galls" (Victoria, Texas, J. D. Mitchell); "bastard hickory" (Beaumont, Texas); "*Hicoria pecan*" (Victoria, Texas); "on *Verbesina virginica*" (Victoria, Texas, R. A. Cushman); "bred from *Phylloxera devastata* gall, *Hicoria pecan*" (Victoria, Texas, J. D. Mitchell); "in cotton field" (Victoria, Texas, W. E. Hinds); "bred from *Phylloxera* gall on hickory" (W. Chester, Pa.); "bred from *Phylloxera* gall" (Baton Rouge, La., T. H. Jones); "on hickory" (Carbondale, Illinois); "collected on pecan" (Raleigh, N. C., R. C. Barnes); and "jarred from plum" (Dubois, Illinois, Taylor).

A correlation of the literature records with the specimen records reveals that in some instances *elegans* (Say) probably has been confused with *aratus* (Germ.) or *tibialis* n. sp. The data listed by Pierce (1916), concerning the first generation, and by Champlain and Knull (1921) indicate feeding, ovipositional, and breeding habits similar, if not identical, to those given by Brooks (1922) for *aratus* (Germ.) or *tibialis* n. sp.\* Consequently, unless corroborative evidence is obtained, the writer is inclined to question the validity of these records as applying to *elegans* (Say).

The specimen records definitely establish this species as breeding in the galls of *Phylloxera* on pecan and hickory. They also indicate its occurrence on hickory, but whether the curculios were actually breeding on or in some part of the tree or were in search of galls is not clear. The literature records of Pierce (1907a) and Hunter (1912, 1916), con-

\*One paratype of *tibialis* n. sp. was collected at Westbury, N. Y., by Champlain on *Hicoria*, May 25, 1916. Champlain and Knull (1921) state that the adults of *elegans* (Say) were first observed at Westbury on May 25. As these writers do not mention *aratus* (Germ.) and as *tibialis* n. sp. was not known, this specimen very likely represents the species they considered as *elegans* (Say).

cerning the ovipositional and larval food habits of *elegans* (Say) on the leaves and nuts of hickory, should be further substantiated before being considered authentic for the species.

As *elegans* (Say) has been reared from galls on pecan, the common name "pecan-gall curculio" appears to be more applicable than the name "pig-nut leaf curculio."

There is one specimen record of this species being attracted to a trap light.

*Remarks:* The species which Say (1831) had in mind when he originally described *elegans* has never been satisfactorily determined. The destruction of Say's types, as in the case of *retentus* (Say), has caused the definition of *elegans* (Say) to be principally a matter of common interpretation among coleopterists. This is due, not only to the fact that Say's original description can now be applied to several species, but also to the tendency of biological or geographic varieties to occur within the species. Say's original description is as follows:

"Body dull piceous, more or less varied with brown or blackish; rostrum sulcated, carinate, piceous: antennae rufous: thorax lobed at the eyes; punctured; an obsolete, oblique, cinerous line each side proceeding to the posterior angles; elytra with four somewhat elevated, acute lines, the exterior ones uniting behind; interstitial spaces wide, with double series of punctures, obsolete behind; behind the middle is a more or less dilated common space, narrower at the suture than on the lateral margin; on this spot the inner elevated line is interrupted, and the line is also depressed or interrupted toward the base; thighs two-toothed, somewhat annulated with piceous and blackish.

"Length less than  $\frac{1}{5}$  of an inch.

"Var. a. somewhat cinereous.

"Var. b. Paler piceous; larger."

Specimens of *C. aratus* (Germ.) or *seniculus* Lec. would fit equally well Say's description. Say has indicated the occurrence of varieties, but since these appear to be based chiefly on color and size, too much significance cannot be placed upon them.

Leconte (1876) gave a more complete description of *elegans* (Say), and in his key distinguished it from *aratus* (Germ.) on the appearance of the postmedian elytral band, this being distinct in *elegans* (Say) and obscure in *aratus* (Germ.). This difference is a comparative one and sometimes of little value unless specimens of both species are available.

Blatchley and Leng (1916) redescribed *elegans* (Say), but their characterization was similar to that of Leconte's. These writers, in their key, separated *elegans* (Say) and *aratus* (Germ.) by abdominal characters in addition to the comparative distinction of the postmedian band. In *elegans* (Say), according to Blatchley and Leng (1916), all the ventral

abdominal segments are closely and rather coarsely punctate and the fifth sternum is without tubercles, while in *aratus* (Germ.) the first and second sterna are very coarsely but not densely punctate and the fifth is finely, more densely punctate and bears two distinct tubercles. These characters of Blatchley and Leng hold in most cases, but there is variation. The abdominal punctuation occasionally tends to be less dense on the first and second sterna in *elegans* (Say), and the fifth sternum may have slight tubercles, while *aratus* (Germ.) may lack distinct tubercles and have a moderately dense abdominal punctuation of the first and second sterna. Such variations lead to confusion, especially when a specimen of either species is lacking for comparison. The characters set forth in the writer's key appear to be stable and will serve for identification with only one specimen on hand. These characters and the description have been based on the examination of the thirty-three specimens listed under neotype and neoparatypes. All specimens have shown a uniformity with regard to the key characters and to the genital structures. Since the original type specimens have been destroyed and since there is a definite need for a criterion upon which to base this species, the writer hereby designates a male specimen from Jefferson Barracks, Missouri, H. Soltan collection (United States National Museum) as the neotype. This specimen and its neoparatypes are what is commonly interpreted as *elegans* (Say).

In the southeastern region particularly, *elegans* (Say) appears to be the center of a large complex of forms, all of which, though closely related to it, show variations from it. The majority of specimens that the writer has examined from the northeastern area, however, have been the typical *elegans* (Say). One male from Massachusetts, considered as belonging to the complex, appears from its genitalia to be more closely related to *aratus* (Germ.).

*C. elegans* (Say) is closely related to *hayesi* n. sp. and *aratus* (Germ.). The latter also appears to be the center of a complex which may be shown to be closely linked to the *elegans* group when the full complement of the species and the variations of both complexes have been investigated.

*Conotrachelus hayesi* n. sp.

*Length:* 4.7-5.1 mm.

*Special characters:* Abdominal sterna 1 and 2 with a moderately dense punctuation, that is, with distinct non-punctate areas present which sometimes are two or more times the diameters of the punctures; post-median elytral band obscure; beak in female with distance (a) approximately three or more times distance (b).

*Color:* Prothorax and elytra uniformly piceous or blackish in female, reddish and black mixed in male.



*Head:* Densely and semi-coarsely punctate; with a sparse covering of light tan and white setae; beak slender (Figs. 37 and 40) and slightly curved, curvature in male more abrupt at position of antennal insertion; beak distinctly longer than prothorax, longer in female (1.9-2.0 mm.) than in male (1.45-1.50 mm.); beak in both sexes distinctly trisulcate laterally from base to above antennal insertion, the median sulcus sometimes evanescent basally; dorsal aspect with a distinctly acute or rounded carina, which in male extends to approximately one-third to one-fourth before apex, and in female to approximately one-half before apex; dorsal aspect distad of carina with dense elongate punctures which are more elongate in male than in female; from dorsal aspect, beak in female feebly constricted in area between antennal insertion and apex, no constriction in this area in male; sparse vestiture of white and tannish setae arising from sulci; antennae in male inserted approximately one-fourth from tip of beak, in female between one-third and one-half, nearer one-third in one specimen, nearer one-half in the other two.

*Prothorax:* Sides sometimes gradually rounded from base to apex, or outline more sharply convergent anterior to middle than posteriorly; coarsely and densely punctate; punctures shallower and several confluent near apex; disc non-carinate and without tubercles; with a sparse vestiture of brownish-yellow and white recumbent to subrecumbent setae, the white setae forming a vague oblique line on each side from inside of basal angle to apex; lines sometimes absent.

*Mesoscutellum:* Prominent, from lateral aspect abruptly declivent basally.

*Elytra:* Approximately two-thirds as wide as long; sides subparallel for more than half, then gradually converging to the apex; basal border feebly emarginate before humeri, the latter not prominent; intervals 3 and 5 feebly to moderately costate; costa of interval 5 interrupted feebly near the base; costa of interval 9 sometimes so feeble behind the middle that it appears to be slightly interrupted; serial punctures coarse from base to before vague postmedian band, smaller apically; sparse vestiture of brownish and whitish recumbent setae; brownish setae chiefly aligned on the non-costate intervals; white setae chiefly on slopes of costae and in punctures, slightly more abundant between middle and posterior elevations of third intervals; brownish setae denser behind middle and with white setae forming a vague, ill-defined, postmedian band.

*Ventral surface:* Metasternum not grooved between meso- and meta-coxae in either sex. Abdominal sterna with punctures moderately coarse in female, between fine and coarse in male, especially on sternum 2; sternum 5 and usually 4 more densely punctate than 1 and 2 and sometimes more than 3; sternum 3 may or may not be more densely punctate

than sterna 1 and 2; sternum 5 laterally depressed, depressions less distinct in male, the latter with a median depression, without or with feeble tubercles; each puncture with a pale amber or whitish fine seta; lateral setae broader and white.

*Legs:* Femoral teeth more prominent in female; metaunci of male dentate (Fig. 28), those of female not dentate; femora and tibiae with a sparse covering of yellow and white setae; setae denser on apical portion of metafemora at position of teeth.

*Male genitalia:* (Figs. 52 and 79). Aedeagus elongate, two and one-half times as long as wide at base and approximately four times as long as the aedeagal struts, sides subparallel, slightly widened at apex; apex feebly bisinuate; dorsal plate merging with lateral plates approximately one-third from base. Length 1.197-1.209 mm., width at base .461 mm., aedeagal struts .187-.286 mm.

This species is named for Professor W. P. Hayes, Department of Entomology, University of Illinois.

*Type locality:* Northern Illinois.

*Holotype:* Male, No. 1, Illinois State Natural History Survey.

*Allotype:* Female, Northern Illinois, United States National Museum Type No. 55124.

*Paratypes:* Northern Illinois; No. 2, ♂, (ISNHS); Henry County, Iowa; April 24, 1939, ♀, (HFS); West Carroll, Louisiana, 1-14, under bark, ♀, (USNM).

*Distribution:* Recorded only from above localities.

*Biology:* No data are available for this species.

*Remarks:* *C. hayesi* n. sp. belongs between *elegans* (Say) and *aratus* (Germ.) resembling in certain respects both of these species. The shape and length of the rostrum is similar to *elegans* (Say), but the abdominal punctation, structure of the meso- and metaunci in the males, and the distinctness of the postmedian elytral band more closely resemble *aratus* (Germ.). The similarity in external characters, however, is not correlated with male genital likenesses. The aedeagus of *hayesi* n. sp. is distinctly different from that of either *elegans* (Say) or *aratus* (Germ.) as can be seen by a comparison of Figs. 51, 52, and 53. In a lateral view, however, the aedeagus of *hayesi* n. sp. (Fig. 79) does resemble that of *elegans* (Say) (Fig. 78) more closely in contour than that of *aratus* (Germ.) (Fig. 80). All specimens of *aratus* (Germ.) or *elegans* (Say), however, even though larger in size than *hayesi* n. sp. have the aedeagus distinctly shorter than this species. The marked genital differences between *hayesi* n. sp. and both *elegans* (Say) and *aratus* (Germ.) indicate that there are probably other unknown species which would fall into this group.

*Conotrachelus aratus* (Germar)

*Cryptorhynchus aratus* Germar, 1824, *Insectorum Species Novae*, Halle, p. 283.

*Conotrachelus aratus* (Germ.) Schönherr, 1837, *Schönh. Gen. Spec. Curc.*, IV, pt. 1, p. 457; Boheman, 1845, *Schönh. Gen. Spec. Curc.*, VIII, pt. 2, p. 26; Leconte, 1876, *Rhynchophora N. A.*, *Proc. Amer. Philos. Soc.*, XV, No. 96, p. 228; Blatchley and Leng, 1916, *Rhynchophora N. E. Amer.*, p. 473; Mutchler and Weiss, 1925, *Conotr. N. J.*, *Circ.* 87, *Bur. Stat. and Insp.*, *Dept. Agr.*, N. J., p. 20.

*Length*: 4.35-5.75 mm.

*Special characters*: Femoral teeth evident in both sexes.

*Color*: Prothorax and elytra piceous, black, and red mixed.

*Head*: Semi-coarsely punctate; punctures sometimes indistinct; with a sparse vestiture of whitish and tannish setae; beak stout and curved (Figs. 38 and 41), curvature sometimes abrupt apically in male; as long as or longer than prothorax, subequal in length in both sexes; beak trisulcate laterally between base and antennal insertion; lower sulcus always distinct, others varying from distinct to obscure, especially the median sulcus which sometimes is replaced by large punctures; dorsal aspect carinate from base to beyond middle; carina in female sometimes evanescent before or at the middle, feeble or moderately prominent, more acute in male; aspect distad of antennal insertion with fine elongate punctures; punctuation moderate to dense, usually more so in male, the surface appearing minutely sulcate; sparse vestiture of tan and white setae arising from sulci; antennae inserted approximately one-fourth from tip in male, nearer one-third in female.

*Prothorax*: Sides gradually rounded from base to near apex, then constricted; densely and coarsely punctate; punctures less distinct apically; with four feeble tubercles on disc, one pair transversely at the middle, the other between median pair and base; median pair most evident and present even when posterior set is obsolete; disc on each side sometimes depressed between median and posterior tubercles; with either a feeble carina from between median tubercles apically or non-carinate; sparse vestiture of elongate tan and white recumbent to subrecumbent setae, white or light tannish setae on each side forming a vague, curved line from inside of basal angle to apical border; lines approach apically but do not meet.

*Mesoscutellum*: From lateral aspect usually sloping steeply basally or abruptly declivent.

*Elytra*: Approximately one-third longer than wide; sides subparallel for more than half, then gradually converging to the apex; humeri rounded, variable in prominence; basal border emarginate (sometimes feebly) before humeri; intervals 3, 5, and 7 feebly to moderately costate;



elevations of interval 3 feeble to moderate, the median one most prominent; costa of interval 5 usually interrupted twice, interruptions sometimes feeble; costa occasionally complete posteriorly, elevations usually feeble; serial punctures feeble to distinct; sparse vestiture of brown, brownish-yellow, tan, and white recumbent setae; relative abundance of each type variable; when whitish setae are well scattered, abundant, and mixed with light-tannish ones, the elytra have a grayish cast; when brownish-yellow and brown setae predominate, a tannish to brownish hue is present; lighter setae condensed in an ill-defined postmedian band and possibly in a brief line at base of interval 3.

*Ventral surface:* Metasternum in male grooved from meso- to metacoxa; grooves absent in female. Abdomen: Punctuation of sterna 1 to 5 varying from moderately dense (Fig. 34) to dense, punctures coarse, those of sternum 1 usually larger than those of sterna 2-5; sterna 3 and 4 usually more densely punctate than 1 and 2; sternum 5 more densely punctured than sterna 1-4, punctures becoming finer apically, usually with two distinct tubercles on either side of the middle apically, tubercles sometimes feeble; each puncture with an elongate, usually fine, pale amber seta; lateral setae broader and white; vestiture usually most evident on sternum 5.

*Legs:* Femoral teeth small; femora and tibiae with sparse vestiture of tan and white setae, most frequent on distal third of metafemora, sometimes forming a band.

*Male genitalia:* (Figs. 53 and 80). Aedeagus one-fourth to one-third longer than wide at base and approximately one-fourth longer than aedeagal struts; apex abruptly narrowed to form a prominent process; dorsal plate broad apically and narrowed at the base; basal border may have a smoother curve than that shown in Fig. 53. Length .796 mm., width at base .531 mm., aedeagal struts .600 mm.

*Type locality:* Kentucky.

*Type:* Zool. Univ. Mus., Halle, a. S.

*Plesiotypes:* ALABAMA: Mobile County, H. P. Loding, ♀ (USNM); ILLINOIS: Urbana, September 9, 1925, V. G. Smith, ♂, (CAF); KANSAS: Riley County, April 24, May F. Marlatt, ♂, 2 ♀, (WPH), ♀, (HFS), ♀, (USNM); Topeka, June 13, Popenoe, ♂, (USNM); Onaga and Wilson County, June 7 and April 23, Wickham, 2 ♀, (USNM); MISSISSIPPI: Poplarville, April 27, 1926, pecan L401, W. B. Tate, ♀, (HFS); Wiggins, March 24, 1929, hickory petioles, J. P. Kislanko, ♀, (USNM); TEXAS: Columbus, May 6, Hubbard and Schwarz, ♀, (USNM).

*Distribution:* Ranges from Massachusetts to Illinois and Kansas, south to Alabama and Mississippi, and southwest to Texas.

*Biology:* Since *aratus* (Germ.) in the past has been confused with *tibialis* n. sp., the biological information given under *tibialis* n. sp. (p. 93) can probably be applied to *aratus* (Germ.) as well. Two specimen records indicate *Hicoria* as a probable host: "pecan" (Poplarville, Miss., L. B. Tate) and "hickory petioles" (Wiggins, Miss., J. P. Kislanko).

*Remarks:* *C. aratus* (Germ.) is another North American species about which a great deal of confusion has arisen. In this instance the type, although possibly still in existence in Europe, is not available, especially at the present time, to American workers.

Germar (1824) described *aratus* with Kentucky as the type locality. It was not again characterized until 1876. At that time Leconte (1876, p. 228) stated that he referred, with some hesitation, to this species a specimen from Texas, 4 mm. in length. Leconte distinguished this specimen of *aratus* (Germ.) from all other members of Group I by the punctuation of the abdominal sterna: first and second very coarsely but not densely punctured, third and fourth strongly punctured, fifth finely and more densely punctate with two distinct tubercles. Blatchley and Leng (1916, p. 473) gave a similar description, asserting that *aratus* (Germ.) could easily be distinguished from allied species by the abdominal punctuation and the presence of the two tubercles on the fifth sternum. Mutchler and Weiss (1925), in a descriptive key, characterized this species by its color, vestiture, and elytral sculpture, all characters of questionable value in this section of the genus.

From this summary, it appears that the abdominal punctuation and tuberculation are the principal characters to rely upon. Germar's original description is general and can also be applied to *elegans* (Say) or *retentus* (Say). Several of the specimens on which the author's redescriptions are based agreed with the type of abdominal punctuation and tuberculation set forth by Leconte. Others, however, show variations, although the specimens are all the same species. Of four specimens from the same locality and of the same date, three show distinct tubercles on the fifth sternum, but the fourth is only feebly tuberculate. The abdominal punctuation also shows similar variation; in specimens from the same locality some show the not-dense punctuation specified by Leconte and Blatchley and Leng, while others have a dense punctuation. Since such variations occur in specimens from the same locality, the writer feels that he is justified in considering these specimens to be *aratus* (Germ.) even though their structures sometimes do not fit exactly the specifications set forth by previous authors. Another character of Leconte and Blatchley and Leng that does not fit some of these specimens is that concerning the non-interruption anteriorly of the elytral costae of the fifth intervals. These

costae are usually interrupted at this point, but they are too variable in form in this section of Group I to be used as definite taxonomic indicators; therefore, such a digression is not significant.

Leconte and Blatchley and Leng also used the prominence of the postmedian elytral band as a means of separating *elegans* (Say) and *aratus* (Germ.). This character is of value, but with only one specimen on hand its use is sometimes limited.

Germar (1824) gave the size of *aratus* as similar to that of *Notaris acriduli*, which varies in length from less than 4 to 5 mm. The specimens interpreted as *aratus* (Germ.) vary from 4.35 to 5.75 mm. Leconte (1876) gave the size of *aratus* (Germ.) as 4 mm., but a measurement of his Texas specimen places the length at 4.35 mm.

*C. aratus* (Germ.) is most closely related to *tibialis* n. sp., from which it is separated by the characters given in the key.

*Conotrachelus tibialis* n. sp.

*Length:* 4.5-5.75 mm.

*Special characters:* Males with proximal femoral tooth absent or obsolete; sides of prothorax sometimes distinctly bulging near apical third.

*Color:* Prothorax and elytra reddish and black mixed.

*Head:* Semi-coarsely and densely punctate; with a sparse vestiture of light tan and pale white setae; beak stout, curved, longer than prothorax (rarely shorter in male), and longer in female than in male; male beak with three lateral sulci from base to above antennal insertion; median sulcus less distinct than others and with large, deep punctures; dorsal face of beak moderately to acutely carinate from base to distad of middle; tip distad of carina densely and finely punctate, punctures so dense that tip appears finely sulcate; female beak with less distinct sulci and with only a feeble carina; sulci and carina sometimes lacking; dorsal surface distad of antennal insertion with fine distinct punctures, moderate to dense in composition; beak in both sexes sparsely covered with white and tan setae which arise from sulci when these are present or from punctures which replace sulci; antennae inserted approximately one-fourth from tip in male, nearer one-third in female.

*Prothorax:* Distinctly wider than long; sides usually rounded, sometimes with a distinct bulging near the apical third; with dense coarse punctures, less evident apically, occasionally with a feeble indication of two tubercles on disc behind middle; sometimes with a feeble longitudinal carina on disc from middle to one-fourth before apex; disc frequently with two depressions behind middle; vestiture sparse, consisting of white and tan recumbent to subrecumbent setae, usually one to a puncture;



lighter setae condensed on each side to form a faint sinuate line from inside of basal angle to apex; lines approach apically but do not meet.

*Mesoscutellum*: From lateral aspect abruptly declivent basally.

*Elytra*: Approximately one-third longer than wide; sides subparallel for more than half, then gradually converging to apex; basal border with feeble emarginations inside of humeri, the latter rounded and not prominent; intervals 3 and 5 feebly to moderately costate; elevations of interval 3 feeble; interval 5 with costa either once or twice interrupted; when only singly broken, interruption either anterior or posterior; costa sometimes acute and occasionally complete; serial punctures large and quadrate anterior to postmedian band, smaller at band and behind it; sparse vestiture of mostly brownish and tannish recumbent setae; whitish setae usually present but not as abundant as darker ones; light tan and light brown setae condensed in a postmedian band, usually vague, rarely distinct; a faint line of light tan setae at base of third interval.

*Ventral surface*: Metasternal grooves absent in both sexes. Abdominal sterna 1-4 coarsely punctate; punctures numerous, sometimes dense; those of sterna 3 and 4 usually slightly denser than those of 1 and 2; sternum 5 more densely and finely punctate than others, punctures on basal third approaching in size those of preceding sternum; punctation on apical half obscure in female; two, usually distinct, tubercles on apical third in male, those of female feeble to distinct; each puncture with a fine, pale amber seta; lateral setae broader, white and pale-white in color, forming obscure patches on sterna 2-5.

*Legs*: Females with femoral teeth small but evident; protibiae usually distinctly mucronate proximad of unci; mucrones present on meso- and metatibiae but difficult to detect; femora and tibiae of both sexes with a sparse vestiture of light tan and whitish setae which are denser on apical third of metafemora than elsewhere.

*Male genitalia*: (Figs. 54 and 81). Aedeagus one-fourth to one-third longer than wide at base, and one-fourth to one-third longer than aedeagal struts; sides slightly widened apically; apex bisinuate and with a distinct process; dorsal plate variable in its extent; basal border of aedeagus sometimes a smooth curve instead of angled as shown in Fig. 54. Length .562-.649 mm., width at base .387-.425 mm., aedeagal struts .379-.476 mm.

*Type locality*: Mendenhall, Mississippi.

*Holotype*: Male, United States National Museum Type No. 54310, April 18, 1911, J. E. Boggan, S:3042 (USNM).

*Allotype*: Female, Mendenhall, Mississippi, April 18, 1911, J. E. Boggan, S:3042 (USNM).

*Paratypes*: IOWA: Mt. Pleasant, May 7, 1930; Jones, ♂, (WPH);

Iowa City, Wickham, ♀, (HFS); ILLINOIS: Southern Illinois, H. Soltau, ♂, (USNM); KANSAS: Wilson County, April 23, 1896, on hickory buds, ♀, (MSC); LOUISIANA: New Iberia, June 6, 1896, Coll. H. Soltau, ♀, (USNM); No. 4676<sup>01</sup>, other data illegible, ♂, (USNM); MASSACHUSETTS: Southboro, May 30, 1923, C. A. Frost, ♀, (USNM); MISSISSIPPI: Poplarville, May 29, 1926, pecan L401, W. B. Tate, ♂, (USNM); MISSOURI: Jefferson Barracks, Coll. H. Soltau, ♂, (USNM); NEW YORK: Westbury, L. I., May 25, 1916, *Hicoria*, A. B. Champlain, ♀, (USNM); WEST VIRGINIA: French Creek, May 29, 1920, F. E. Brooks, Quaintance No. 21101, jarred from branches of young hickory trees, identified as *C. aratus*, ♂, (HFS), ♀, (USNM).

*Distribution:* Ranges from Massachusetts and New York to Iowa and Kansas, south to Mississippi and Louisiana.

*Biology:* As both *tibialis* n. sp. and *aratus* (Germ.) have been considered as *aratus* (Germ.) in the past, it is difficult to evaluate the available biological literature. From specimen records both species appear to have the same host, *Hicoria*, and in all probability their life histories are somewhat similar. Brooks (1922) gives an account of the biology of *aratus* (Germ.), but on the basis of the information on two paratypes (Quaintance No. 21101) the species with which he worked was *tibialis* n. sp. In this study Brooks' data, therefore, are discussed under *C. tibialis* n. sp. One definite record, however, does not eliminate the possibility that Brooks also worked with *aratus* (Germ.), since the two species have the same host and are very similar in appearance. Consequently, the writer feels that Brooks' data may also, in the absence of more definite information, be applied equally well to *aratus* (Germ.).

*C. tibialis* n. sp. has been recorded only from hickory, Brooks (1922) listing it as attacking *Hicoria minima*, *H. ovata*, *H. alba*, *H. glabra*, and *H. pecan*. The tender tips and leaves of these trees usually wither and drop as a result of the egg-laying and feeding of the curculio. No instance of serious loss from its activity, however, has as yet been reported. In the spring, soon after the hickory buds open, the curculios emerge from hibernation, the females commencing oviposition when the shoots are but a few inches long. Each egg is placed in a shallow cavity at the side of an elongate slit made in the bark of the twigs and leaf petioles. During this period of oviposition the adults also feed on the young growth. The egg hatches about a week after deposition, the resultant larva usually feeding in the center of the bulb-like swelling at the base of the leaf petiole. Sometimes it also mines the pith of the shoots and leaf stems. Larval activity occurs in the spring and early summer when the growth is new and tender. When full grown the larvae burrow one-half to two inches below the surface of the soil for pupation. Two to three weeks

later (midsummer) the adults issue from the ground. In autumn they go into hibernation until spring.

Brooks (1922) states that during the period of his investigations at least 50% of the larvae died from parasitism. Three parasitic flies, *Myiophasia globosa* Towns., *Cholomyia longipes* Fab., and *Chaetochlorops inquilina* Coq., as well as an unidentified species of hairworm, were reared from larvae.

The work of *tibialis* n. sp. has sometimes been ascribed to *C. elegans* (Say).

*Remarks:* The remarkable form of the protibiae and the aedeagal differences easily separate the males of *tibialis* n. sp. from *aratus* (Germ.). The females, on the other hand, are difficult to distinguish, and the characters given in the key appear to be the best indicators of specific distinction. The writer is not completely satisfied with these characters since occasionally a female specimen turns up which by their use might possibly be referred to either species.

## GROUP II

The species listed under this group were divided into two groups by Leconte and Horn (1876, p. 421) and Blatchley and Leng (1916, p. 467). The characters which these writers used for the separation of the two groups were based on the structure of the beak, which in one group was slender and much longer than the head and thorax, while in the other it was rather stout, curved, and scarcely longer than the head and thorax. From a study of the species in these two groups it appears that the above writers had before them when they erected these groups only females of several of the species in the long-beaked group. In addition, by examination of Leconte's types, it has been ascertained that he had only the females of *adspersus* Lec. and *naso* Lec. before him, and this fact in all probability led to his arrangement of the key which Blatchley and Leng have followed. The key of these workers is valid when females alone are considered. Unfortunately, the males of the long-beaked group have snouts that resemble those of the short-beaked group, and this fact nullifies the validity of the key. Therefore, it has been necessary to consolidate these two groups into one in order to obtain a key which would avoid the confusion introduced by the use of the beak as a group characteristic.

In addition, the division of Group II into two parts by these authors placed the species of *naso* Lec. and *posticatus* Boh. in different groups. Examination of these species shows that the form of the aedeagus, shape of the mesosternum, prothoracic sculpture, abdominal punctation, shape of the male metaunci, and elytral sculpture (especially the presence of



the costate first and second elytral intervals in the males) are extremely similar in both species and indicate a very close relationship between the two. Consequently, it appears to the writer that to put these two species in separate groups would be wholly ignoring an obvious affinity.

In the past, Group II has been known as the "*crataegi* group." As *crataegi* Walsh is phylogenetically isolated from the other species in the group (as well as from all other known species of United States *Conotrachelus*) this designation is an unfortunate misnomer. As in Group I, reference to any one species as typifying the group should be omitted.

Group II is here characterized by the presence of one femoral tooth, but a second feeble tooth (denticle) is usually present in *cribricollis* (Say); relative length of first and second funicular segments of antennae variable; prothorax wider than long, longitudinally carinate or not carinate; mesoscutellum from lateral aspect abruptly declivent basally; elytral intervals 3, 5, 7, and 9 acutely costate, feebly convex, or flattened; costae, when present, usually complete, intervals never with abrupt elytral elevations; vestiture of recumbent setae, scales, or scale-like setae; suberect to erect setae usually present on elytral intervals and sometimes in prothoracic punctures; recumbent setae not condensed in a broad postmedian band; metasternum in male never grooved from meso- to metacoxa; male sometimes with dentate metaunci; aedeagus with a dorsal membrane (except in *crataegi* Walsh), frequently with an apical process, and with the transfer apparatus a complex of sclerotized bars.

#### KEY TO SPECIES OF GROUP II

1. Humeri truncate and dentiform; prothorax prominently and broadly elevated in the median discal area; aedeagus with dorsal plate, the latter cleft apically (Fig. 57).....*crataegi* Walsh, p. 96
- 1- Humeri not truncate or dentiform; prothorax never prominently elevated in the median discal area; aedeagus with a dorsal membrane, never as shown in Fig. 57..... 2
2. First funicular segment of antenna as long as the second and third combined; beak distinctly longer than the prothorax; aedeagus as shown in Fig. 58; length 6.5-7.2 mm.....*adspersus* Leconte, p. 99
- 2- First funicular segment of antenna usually subequal to the second only, rarely equal to the second and third combined; if so, the specimens will be less than 3.2 mm., have the beak and prothorax subequal in length, and have the aedeagus as shown in Fig. 63..... 3
3. Prothorax with a distinct longitudinal, median carina; mesosternum with anterolateral angles truncate and prominent..... 4
- 3- Prothorax not carinate; mesosternum never with anterolateral angles truncate and prominent..... 6
4. Profemoral tooth absent or obsolete, the apical ventral emargination of the profemur (viewed posteriorly) broad (Fig. 96).....*naso* Leconte, p. 101
- 4- Profemoral tooth distinct, the apical ventral emargination of the profemur deep and more acute (Figs. 97 and 98)..... 5

5. Male: metaunci dentate; antennal insertion almost reaching lateral apical emargination of beak (Fig. 108); protibia bearing on its apical margin, adjacent to uncus, long, slender, curved, light-tannish setae; setae much longer than uncus and usually in a tuft, sometimes also present on mesotibia; elytral interval 2 not costate; aedeagus as shown in Figs. 99 and 103; female: metaunci not dentate; beak slender (Fig. 101), the distance (a) between lateral apical emargination of beak and anterior margin of ball of antennal scape three or more times the distance (b) between dorsal and ventral surfaces of beak at position of antennal insertion (Figs. 101 and 105).....*carinifer* Casey, p. 104
- 5- Male: metaunci dentate; a distinct area between antennal insertion and lateral apical emargination of beak (Fig. 109); apical margin of protibia without a tuft of long, curved, light-tannish setae; elytral interval 2 usually distinctly costate anterior to the apical declivity; aedeagus as shown in Figs. 60 and 87; female: metaunci not dentate; beak moderately stout (Fig. 102), the distance (a) less than twice the distance (b).....*posticatus* Boheman, p. 106
6. Vestiture of oblong to elongate, recumbent setae, never of broad scales; elytral intervals each with a row of short or long suberect setae; prothorax with sparse vestiture, punctures clearly evident; aedeagus either sharply convex (Fig. 88) or trilobed apically (Fig. 62)..... 7
- 6- Vestiture of broad scales; elytral intervals each with a row of subrecumbent, recurved setae; prothorax with dense vestiture concealing punctures; aedeagus as shown in Figs. 63 and 90.....*recessus* (Casey), p. 109
7. Prothorax with 11 to 13 punctures from base to apex along the median line; punctures dense and deep but not forming longitudinal ridges; abdominal sterna not roughly punctate; sterna 2 to 5 never with numerous suberect elongate setae; aedeagus distinctly convex (Fig. 88), not trilobed apically (Fig. 61).....*geminatus* Leconte, p. 111
- 7- Prothorax with 6 to 8 large punctures from base to apex along the median line; punctures dense and extremely deep, forming frequent tortuose longitudinal ridges; abdominal sterna roughly punctate; sterna 2 to 5 with scattered, usually numerous, suberect elongate setae; aedeagus not convex (Fig. 89), trilobed apically (Fig. 62).....*cribricollis* (Say), p. 114

### *Conotrachelus crataegi* Walsh

*Conotrachelus crataegi* Walsh, 1864, Proc. Bost. Soc. Nat. Hist., IX, p. 311; Leconte and Horn, 1876, Rhynchophora N. A., Proc. Amer. Philos. Soc., XV, No. 96, p. 230; Provancher, 1877, Faune Ent. Can. I Col., p. 528; Blatchley and Leng, 1916, Rhynchophora N. E. Amer., p. 474; Mutchler and Weiss, 1925, Conotr. N. J., Circ. 87, Bur. Stat. and Insp., Dept. Agr., N. J., p. 20.

*Length:* 3.75-5.75 mm.

*Special characters:* Crest of prominent median prothoracic elevation carinate from behind middle to before apex; sides of elytra converging from just behind base to apex; mesosternum emarginate and with prominent anterolateral processes; abdominal sterna 3 and 4 usually with only a few shallow punctures, surface frequently smooth.

*Color:* Prothorax and elytra reddish-brown, piceous, and black mixed.

*Head:* Densely punctate; with a sparse to moderately dense covering of mostly tan scales, but also a few white ones; beak moderately stout

and curved; longer than prothorax, slightly longer in female than in male; trisulcate laterally between base and antennal insertion; upper and median sulci evanescent basally, distinct and prominent apically; dorsal surface with a feeble rounded carina at the most; surface distad of antennal insertion with fine, elongate punctures, moderately dense to dense in composition; beak with a sparse to moderately dense vestiture of light-brown and white setae arising in the sulci; antennae inserted approximately one-fourth to one-third before apex; first and second funicular segments subequal in length and longer than any of the remaining segments; second segment longer than segments five and six combined; sixth and seventh segments globose.

*Prothorax*: Sides subparallel until near apex, then abruptly constricted; point of constriction sometimes tuberculate; coarsely and densely punctate; punctation usually obscured to a large degree by dense vestiture; disc occasionally with a tubercle on each side of median elevation; moderately dense to dense vestiture of white, grayish, and tan scales and scale-like setae, the tannish vestiture in basal discal area and along lateral surfaces, the white usually covering the apical half of the disc and forming a broad curved band to the basal angle on each side; tannish scale-like setae sometimes the most abundant, so that above pattern is altered, the white scale-like setae merely forming on each side a curved line from basal angle to median elevation, the remainder of prothorax being tannish; suberect dark tan and white setae scattered amid the predominant recumbent vestiture; vestiture less dense on lateral surfaces.

*Elytra*: More than four-fifths as wide as long; sides gradually converging from base to apex; convergence more abrupt one-fourth or less before the apex; basal border feebly emarginate before humeri; the latter truncate, prominent, and with their apical angles dentiform; intervals 3, 5, 7, and 9 usually strongly costate; costae usually complete, but those of intervals 3 and 5 sometimes showing feeble interruptions; costa of interval 3 sometimes flattened both anteriorly and posteriorly, that of interval 5 anteriorly; interval 8 with a brief basal ridge which, by its acute junction with the humerus, causes the latter to appear dentiform at its apical angle; occasionally a true denticle develops at this point; serial punctures large, smaller apically; punctures usually obscured by vestiture; moderately dense vestiture of tan, grayish, and white, oblong and tapering, scales or scale-like setae; vestiture pattern variable; tannish vestiture usually predominant with the scale or scale-like setae varying from light to dark tan (brownish), so that elytra sometimes are mottled in appearance; white scales or scale-like setae occasionally abundant mesad of the humeri and in basal discal area; white elongate or scale-like setae arising from the punctures and aligned sparsely but distinctly on the flattened



intervals, also present on costate intervals but arrangement less uniform, those of punctures usually much shorter than those of flattened intervals, these setae quite prominent when remainder of vestiture is dark tan.

*Ventral surface:* Abdominal sterna 1 and 2 coarsely and sparsely to moderately punctate; punctures of sternum 2 slightly coarser than those of 1 but less dense in composition; sometimes apical third of 2 is non-punctate and smooth; sterna 1 and 2 also with smaller punctures interspersed among the large coarse ones; sterna 3 and 4 with punctures much smaller than those of the preceding sterna, surface frequently smooth with only a faint indication of punctation, punctures in some cases distinct; sternum 5 more finely punctate than sterna 1 to 4, punctures moderately dense to dense, with two faint tubercles and with lateral and median depressions; sterna with a covering of tan (sometimes with an orange tinge) and white setae; vestiture denser on sterna 1 and 2 than on 3, 4, and 5, except laterally on 3, 4, and 5 where distinct patches are formed.

*Legs:* Femoral tooth distinct; metaunci non-dentate in both sexes; femora and tibiae with a moderately dense to dense vestiture of recumbent tannish oblong scales or scale-like setae; among which suberect white and tan elongate setae frequently arise.

*Male genitalia:* (Figs. 57 and 84). Aedeagus approximately twice as long as wide at base; aedeagal struts long, sometimes three-fourths as long or equal in length to aedeagus; apex feebly bisinuate; dorsal plate distinct, narrow on basal half, then widened abruptly, cleft at apex, feebly extended to base; transfer apparatus with a pair of stout lateral bars. Length .750-.875 mm., width at base .375-.399 mm., aedeagal struts .625-.812 mm.

*Type locality:* Illinois.

*Type:* Male, Museum of Comparative Zoology Type No. 8434, J. L. Leconte Collection (MCZ).

*Distribution:* "Ranges from New England to Michigan and Iowa, south to Georgia," Blatchley and Leng, (1916). Range extended north to Ontario and west to Kansas and Texas. Records from: Arkansas, Connecticut, Georgia, Illinois, Iowa, Kansas, Louisiana, Maryland, Massachusetts, Mississippi, Missouri, New Jersey, New York, Ohio, Ontario, Pennsylvania, Texas, Vermont, Virginia, West Virginia, Wisconsin.

*Biology:* *C. crataegi* Walsh is an important economic pest of quince, being considered by Slingerland and Crosby (1930) and by Peairs (1941) as the most serious insect enemy of this fruit. Infested quinces are misshapen and knotty. The life-history, summarized from Slingerland (1898), Wellhouse (1922), and Peairs (1941), is as follows: The curculio overwinters as a larva, 2 to 3 inches below the surface of the

soil. Pupation occurs in the spring, the adults emerging from the ground in June and July and feeding on the growing fruit and, to some extent, on the leaves. The females gouge pits in the fruit and deposit one egg in each pit. The resultant larvae feed on the pulp, one larva commonly consuming about one-half of the entire pulp before dropping to the ground (August and October) and entering the soil. There is one generation in a year, and the insect may spend from 7 to 11 months in the soil.

Slingerland (1898) reports that *crataegi* Walsh breeds in pear, peach, quince, and hawthorn. Wellhouse (1922) states that it is common on all native hawthorns. Host records from specimens have been limited to these plants.

*Remarks:* *C. crataegi* Walsh is common in Illinois. The presence of the dentiform humeri and the gradual tapering convergence of the elytra from their wide base to the apex easily distinguishes *crataegi* Walsh from its allied species, none of which appear very closely related to it. The aedeagus of this species does not bear any resemblance to the aedeagi of the other species studied. In form and general structure *crataegi* Walsh is also distinct from those species not included in this study which would fall into this group. It appears to be clearly different from, and not closely related to, any other known *Conotrachelus* in the United States.

Walsh's original description was published in the Proceedings of the Boston Society of Natural History, Vol. IX, for the year 1863, but the actual date of publication was March, 1864 (*loc. cit.*, bottom of page 305). Previous citations for this species have indicated 1863 as the date of publication, which is incorrect. Walsh's description was also published in *Prairie Farmer*, n. s., Vol. 12, No. 2, July 11, 1863, p. 21; but as this agricultural journal is not a technical publication, this earlier description is invalid.

*Conotrachelus adspersus* Leconte

*Conotrachelus adspersus* Leconte, 1876, *Rhynchophora* N. A., *Proc. Amer. Philos. Soc.*, XV, No. 96, p. 230.

*Length:* 6.5-7.25 mm.

*Special characters:* Beak not sulcate; rarely a feeble lateral sulcus in male dorsad of antennal groove; prothorax, at the most, with only a faint indication of a median longitudinal carina; mesosternum without antero-lateral processes.

*Color:* Prothorax and elytra a uniform dark red, sometimes piceous.

*Head:* Densely and finely punctate; with a sparse covering of tan and white scales or scale-like setae; beak straight to antennal insertion, then distinctly curved; beak longer than prothorax, longer in female, sometimes

reaching the base of the abdomen (in female more than 3 mm. in length, in male less than 2.5 mm.); surface with fine elongate punctures varying from sparse to dense; dorsal surface in male sometimes finely carinate from base to above antennal insertion; beak bare except for a few setae basally; antennae in male inserted approximately one-half or less from apex, in female distinctly more than one-half; third funicular segment distinctly longer than the fourth.

*Prothorax*: Sides subparallel from base to middle, then gradually converging apically; with dense, moderately coarse punctures; disc non-tuberculate; dorsal surface with a moderately dense vestiture of light-tan and white elongate or scale-like recumbent setae; setae sparse in median discal area from base to middle, sometimes from base to apex, so that denser lateral vestiture forms a broad band on each side; bands may or may not unite apically; lateral surfaces with sparse vestiture.

*Elytra*: One-fourth longer than wide; sides subparallel for approximately half, then gradually converging to the apex; basal border feebly emarginate before humeri; the latter not prominent, obliquely rounded; intervals 3 and 5 feebly costate from approximately one-half to apex, anterior to middle usually non-costate, costae becoming more evident apically, sometimes acute, especially that of interval 3; interval 7 feebly costate, costa sometimes extending from base to apex; serial punctures coarse, sometimes hidden by vestiture; with a moderately dense vestiture of white and tan or pale gray recumbent scales or scale-like setae; the tan or pale gray setae condensed in intervals 2, 4, 6, and 8 to form vittae, the white ones aggregated in small patches between the serial punctures, the arrangement of setae and scales giving elytra a very mottled appearance, the white scales also condensed basally near humeri and at interval 3; each interval sometimes with a row of subrecumbent white setae.

*Ventral surface*: Mesosternum usually straight anteriorly, sometimes feebly and broadly emarginate. Abdominal sterna with a moderately dense to dense punctation; punctures fine to moderately coarse; those of sterna 1 and 2 sometimes less dense than those of the sterna 3, 4, and 5; sternum 5 sometimes more coarsely punctate than sterna 1 to 4, especially apically, without tubercles and usually not depressed; sterna sparsely clothed with elongate setae, chiefly white, but also a few light tan ones; lateral setae broader and forming small patches on sterna 3, 4, and 5.

*Legs*: Femoral tooth usually feeble, that of metafemur most evident; metaunci not dentate in either sex; femora and tibiae with a sparse vestiture of light tan and white scale-like setae; metafemora sometimes with a narrow annulation at position of tooth.

*Male genitalia*: (Figs. 58 and 85). Aedeagus approximately two and one-half times as long as wide at base and more than twice the length of



the aedeagal struts; sides subparallel to apical sixth, then converging; apex feebly bisinuate; dorsal area membranous and V-shaped at apex; a pair of short U-shaped bars under membrane (bars not shown in Fig. 58). Length 1.43 mm., width at base .574 mm., aedeagal struts .601 mm.

*Type locality:* Kansas.

*Type:* Female, Museum of Comparative Zoology Type No. 5216, Popenoe, J. L. Leconte Collection (MCZ).

*Distribution:* Limited to Kansas principally. Also taken in Illinois, and Drury records it from Ohio. Records from: Illinois and Kansas.

*Biology:* The only available biological data are two specimen records: "on flowers" (Riley Co., Kansas, Towne) and "on *Helianthus*" (Kansas).

*Remarks:* This large species with its conspicuously mottled elytra is readily distinguished from other species by the characters given in the key. Its closest relative is *invadens* Fall, a unique species from El Paso, Texas, which resembles *adspersus* Lec. in form but differs from it chiefly by the presence of erect elytral bristles and by the third funicular segment of the antennae being scarcely as long as the fourth.

#### *Conotrachelus naso* Leconte

*Conotrachelus naso* Leconte, 1876, Rhynchophora N. A., Proc. Amer. Philos. Soc., XV, No. 96, p. 231; Blatchley and Leng, 1916, Rhynchophora N. E. Amer., p. 475; Mutchler and Weiss, 1925, Conotr. N. J., Circ. 87, Bur. Stat. and Insp., Dept. Agr., N. J., p. 21.

*Conotrachelus cinereus* Van Dyke, 1930, New Rhynchophora from Western North America, Pan-Pac. Ent., VI, No. 4, p. 158 (new synonymy).

*Length:* 4.8-6.6 mm.

*Special characters:* Femoral tooth feeble or obsolete, that of meta-femur most evident; prothorax densely but not deeply punctate; female beak slender and in repose reaching base of abdomen, the distance (a) 7 to 9 times the distance (b); with antennal insertion approximately one-half before the apex; male beak stouter, in repose only reaching metasternum, with antennal insertion one-fourth from apex.

*Color:* Prothorax and elytra dark reddish-brown; elytra with black splotches which sometimes are quite numerous.

*Head:* Densely punctate; sparsely covered with light tan and white elongate setae; basal setae finer; beak in male distinctly trisulcate laterally between base and antennal insertion, dorsal surface with a feeble rounded carina from base to distad of middle, surface distad of antennal insertion with fine, elongate punctures, dense along lateral areas, punctures forming small sulci; beak in female shiny, trisulcate laterally between base and antennal insertion, lower sulcus distinct, median and upper sulci fre-

quently feeble, the upper one sometimes being marked only by a row of closely-set, fine, elongate punctures, not carinate, dorsal tip distad of antennal insertion with fine elongate punctures, subapically dense and covering the entire surface, near antennal insertion sparse and arranged along lateral edges, the median area being smooth; sparse vestiture of pale setae present in the sulci, female beak frequently bare; second funicular segment of antennae elongate, usually longer than first and subequal to or longer than segments four and five combined, sixth and seventh not globose, sides subparallel or tapering toward base.

*Prothorax*: Sides smoothly rounded from base to apex, constricted just before apex; occasionally curvature slight so that sides appear subparallel; very densely punctate; punctures large but shallow, prominently confluent apically; with a distinct longitudinal median carina from base to apex; without tubercles; extremely sparse vestiture of pale tan and white (sometimes pale pink), recumbent to subrecumbent, elongate setae; a few broader white setae frequently forming four small spots transversely behind the middle, the discal spots usually the most evident.

*Elytra*: Approximately one-third longer than wide; sides distinctly subparallel for more than half, then gradually converging to apex; basal border emarginate before humeri; the latter not prominent, obliquely rounded; intervals 3, 5, 7, and 9 acutely and completely costate; possibly a very feeble indication of an interruption anteriorly on costae of intervals 3 and 5; males usually with intervals 1 and 2 also acutely and completely costate, that of interval 1 usually extending from base to apical declivity, that of 2 attaining the apical declivity but usually evanescent anteriorly, sometimes barely evident; females with interval 1 sometimes feebly costate; serial punctures coarse and closely set; with a sparse to moderately dense vestiture of pale tan or brown, tan, and white recumbent elongate setae, frequently tapering; white setae scattered in small aggregates along costae and at base of intervals 3 and 6, denser and sometimes forming a narrow transverse band postmedianly; pale brown and tan setae chiefly in non-costate intervals, the tannish setae sometimes replacing the white ones at base of intervals 3 and 6; the above pattern varying, depending on density of setae; each interval set with short, suberect, pale tan to brown, sometimes white, blunt-tipped setae which are sometimes difficult to detect.

*Ventral surface*: Metasternum protuberant anteriorly, deeply emarginate, and with anterolateral projections. Abdominal sterna with dense, medium-sized, deep punctures; fifth sternum usually depressed medianly, sometimes tuberculate; each puncture with a pale tan, amber, or white elongate seta; setae both recumbent and suberect, sometimes almost entirely suberect, giving venter a "bristly" appearance.

*Legs:* Metaunci in male dentate, those of female not dentate; legs with a sparse covering of white and tannish setae; vestiture denser on apical area of metafemora; the latter sometimes annulated.

*Male genitalia:* (Figs. 59 and 86). Aedeagus twice as long as wide and twice as long as aedeagal struts; sides subparallel to apical fifth, then converging to form a distinct apical process; inner curvature variable in form basally; dorsal membrane sinuately V-shaped; transfer apparatus consisting of a complex of bars of which the elongate lateral pieces are the most distinct; lateral and ventral pieces protruding into prephallogtremic area, especially the lateral ones; laterally, aedeagus has an extreme basal extension of the basal ventral angle. Length .974-1.18 mm., width at base .474-.536 mm., aedeagal struts .375-.461 mm.

*Type locality:* Texas.

*Type:* Female, Museum of Comparative Zoology Type No. 5222, J. L. Leconte Collection (MCZ).

*Distribution:* "Ranges from New York to Indiana, south to Florida and Texas," Blatchley and Leng (1916). Range extended northwest to Minnesota and west to Iowa. Records from: Arkansas, District of Columbia, Florida, Illinois, Iowa, Kansas, Louisiana, Maryland, Michigan, Minnesota, Mississippi, New Jersey, North Carolina, Oklahoma, Pennsylvania, Texas, and Virginia.

*Biology:* *C. naso* Lec. is recorded by Pierce (1907a) as breeding in the fruit of *Crataegus* and in the acorns of post oak (*Quercus stellata*) and live oak (*Q. virginiana*); and by Brooks (1910) as breeding in acorns of white (*Q. alba*) and chestnut oak (*Q. montana*). *C. naso* Lec. attacks the acorns of many species of *Quercus*. According to data taken from specimens, it has been bred from acorns of: *Q. virginiana* (Georgetown, S. C.; Pas Christian, Miss.; Arlington, Va.; and Victoria and Boerne, Texas); *Q. velutina* (Boerne, Texas; District of Columbia; and Arkansas); *Q. brevifolia* (Alvah, Fla.); *Q. rubra* and *Q. pedunculata* (District of Columbia); *Q. alba* (Ruston, La.; Arlington, Va.); *Q. stellata*, *Q. durandii*, and *Q. nigra* (Victoria, Texas). In addition, *naso* Lec. has been taken "on cotton" at Valdosta, Georgia; McCloud, Oklahoma; Victoria and Pt. Loraca, Texas; and "on dogwood" in Riley County, Kansas.

At French Creek, W. Va., Brooks (1910) reports that the eggs are deposited in the acorns in the fall, sometimes a dozen or more to an acorn. The resultant larvae leave the acorns the subsequent winter and spring and pupate in the ground, the adults appearing about midsummer. Pierce (1907a) states that J. D. Mitchell at Victoria, Texas, obtained 266 larvae from 167 acorns of *Q. virginiana* between October 7 and 14. These larvae entered the ground immediately; the first pupa appeared March 7, the



first adult April 2. These data of Brooks and Pierce appear to be the only information available on the life-history of this species.

*C. naso* Lec. has been collected "at lights" at Glen Echo, Maryland; Raleigh, North Carolina; College Station, Texas; and Maywood, Virginia.

*Remarks:* *C. naso* is closely related to *posticatus* Boh., *carinifer* Csy., and *integer* Csy., a species which is confined to the southwest and therefore not considered in this study. Nothing definite can be stated concerning the interrelations of the three species studied, other than that all three form a compact group. This is evidenced by the form of their aedeagi (Figs. 59, 60, and 99), rostral characteristics, and habitus, as well as by similarities in host plants. The order in which these three species are placed in this report is not intended to show their exact phylogenetic arrangement.

Dr. E. C. Van Dyke has informed the writer that *cinereus* Van Dyke is but an extreme of *naso* Lec., being somewhat darker, and having the elytra more sharply narrowed and more prominently costate.

#### *Conotrachelus carinifer* Casey

*Conotrachelus carinifer* Casey, 1892, Ann. N. Y. Ac. Sci. VI, p. 440.

*Length:* 4.75-5.70 mm.

*Special characters:* Prothorax with dense deep punctures, which have distinct sides; beak in male trisulcate laterally, in female unisulcate, the other sulci obsolete; humerus with an oblique, usually prominent, patch of yellow or tannish setae; metafemoral tooth distinct.

*Color:* Elytra dark reddish-brown with a few small black areas; prothorax piceous to black, darker than elytra.

*Head:* Densely punctate and with a sparse to moderately dense vestiture of yellow, tan, or pale dusty pink elongate setae; beak in male curved and longer than prothorax, curvature abrupt distad of antennal insertion, trisulcate laterally between base and antennal insertion, lower sulcus distinct, the median and upper ones sometimes evanescent basally, especially the median one, dorsal aspect broadly carinate from base to position of antennal insertion, area distad of carina densely punctate; beak in female curved (Fig. 101) and with a lateral sulcus above the antennal groove, the usual median and upper sulci obsolete, the upper one represented by a row of fine punctures, dorsal surface not carinate but with fine sparse punctures which are scattered over the surface distad of antennal insertion but arranged laterally towards the base so that a median non-punctate area remains; with a very sparse vestiture of pale fine setae; setae lacking in female except near margin of eye; antennae

with second funicular segment longer than first and subequal to or longer than third and fourth segments combined.

*Prothorax*: Sides usually rounded, sometimes subparallel to near apex, then constricted; with dense, coarse, reticulate punctures, frequently confluent; with a prominent longitudinal median, frequently tortuose, carina from base to apex, sometimes short of base; each puncture with a suberect or erect seta; color of setae varying from pale brown and tan to pale gray and white.

*Elytra*: One-fourth to one-third longer than wide; sides subparallel for approximately one-half, then gradually converging to apex; humeri rounded but not prominent; basal border feebly emarginate mesad of humeri; intervals 3, 5, 7, and 9 feebly to moderately costate; costae complete, those of intervals 7 and 9 frequently evanescent posteriorly; serial punctures deep and closely set; with a sparse to moderately dense vestiture of brown, tannish, yellow, and white, elongate and tapering, recumbent setae; white and lighter-colored setae forming a usually faint narrow postmedian band, and frequently scattered over the surface in small aggregates; light tan and yellowish to whitish setae condensed at base of interval 3 to form a small patch and at base of intervals 6 and 7 to form a usually conspicuous oblique patch across humerus; elytra frequently glabrous in spots, so that general appearance of vestiture is mottled; intervals sparsely set with rows of chiefly pale tan and also white, blunt-tipped, suberect setae.

*Ventral surface*: Mesosternum emarginate anteriorly. Abdominal sterna densely and coarsely punctate; fifth sternum without tubercles, usually depressed medianly and laterally; each puncture with a pale tan or white subrecumbent to suberect seta, sometimes giving the venter a "bristly" appearance.

*Legs*: Pro- and metafemoral tooth distinct, that of mesofemur frequently feeble or obsolete; sparse to moderately dense vestiture of tan to white, elongate and tapering setae.

*Male genitalia*: (Figs. 99 and 103). Aedeagus twice as long as wide and twice as long as aedeagal struts; sides converging on apical third to form an acute process; dorsal membrane V-shaped apically, variable in its basal extent, sometimes almost obliterated by lateral plates; transfer apparatus a complex of bars, with the elongate lateral pair most evident and protruding into the prephallotremic area; laterally, apical process usually not hooked, sometimes similar in shape to that of *posticatus* Boh. (Fig. 87). Length 1.00-1.05 mm., width at base .475-.500 mm., aedeagal struts .435-.475 mm.

*Type locality*: Austin, Texas.

*Type:* Male, United States National Museum Type No. 37425, T. L. Casey Collection (USNM).

*Distribution:* Records below indicate a probable range from New Jersey west to Missouri, south to Georgia, and southwest to Texas. Records from: Georgia, Missouri, New Jersey, North Carolina, eastern Texas, and Virginia.

*Biology:* The only available biological data on this species are a few specimen labels: "bred from *Quercus velutina*, issued Sept. 10, 1906" (Boerne, Texas); "bred from *Quercus nigra* acorn" (Victoria, Texas, J. D. Mitchell); "in acorns, *Quercus velutina*, issued May, 1906" (Boerne, Texas, G. A. Schattenberg); "in molasses trap" (S. W. Mt. Albermarle Co., Virginia, 1000 ft. J. M. Valentine). These records show that *carinifer* Csy. breeds in the acorns of black oak and black jack oak. Its life history is probably similar to that of the other acorn curculios, *naso* Lec. and *posticatus* Boh.

*Remarks:* The affinities of the *C. carinifer* Csy. are considered on page 104. From the description of *C. lucanus* Horn (1895), there is a possibility that it is a synonym of *carinifer* Csy. Horn's description agrees with that of *carinifer* Csy., except in the statement that the serial punctures of the elytra are not densely placed. Until the type is checked, however, no definite conclusion can be made.

Casey (1892) gives the length of the type specimen as 4.30 mm., but a measurement of the specimen reveals it to be 4.75 mm.

#### *Conotrachelus posticatus* Boheman

*Conotrachelus posticatus* Boheman, 1837, Schönh. Gen. Spec. Curc., IV, pt. 1, p. 406; (Say), 1831, Desc. N. A. Curc. New Harmony, Indiana, p. 19, *n.n.*; in Writings of Thomas Say, ed. Leconte, 1859, p. 285, *n.n.*; Leconte and Horn, 1876, Rhynchophora N. A., Proc. Amer. Philos. Soc., XV, No. 96, p. 232; Provancher, 1877, Faune Ent. Can., I, Col. p. 529; Champion, 1904, Biol. Cent. Amer., IV, pt. 4, p. 403; Blatchley and Leng, 1916, Rhynchophora N. E. Amer., p. 477; Mutchler and Weiss, 1925, Conotr. N. J., Circ. 87, Bur. Stat. and Insp., Dept. Agr., N. J., p. 21.

*Length:* 4.25-5.00 mm.

*Special characters:* Prothorax with dense but not deep punctures, the punctures never with distinct sides; beak in both sexes trisulcate laterally, metafemoral tooth distinct, prounci of male usually long and extremely acute.

*Color:* Elytra dark reddish-brown with black splotches, black sometimes predominant; prothorax usually darker than elytra.

*Head:* Densely punctate and with a sparse to moderately dense covering of pale tan or pinkish (sometimes orange) tapering setae; beak



feebly curved and longer than prothorax, curvature usually more abrupt apically; beak equal in length in both sexes; strongly trisulcate laterally between base and antennal insertion; median sulcus sometimes evanescent basally; lower sulcus possibly subdivided; dorsal surface with a distinct to broadly-rounded carina from base to distad of middle, sometimes feeble in female; dorsal surface distad of antennal insertion in male with dense elongate punctures which form small sulci; in female punctures quite dense along the lateral areas but sparse in median area; sulci sparsely set with elongate, pale tan and white setae; antennae in both sexes inserted approximately one-fourth from apex; first and second funicular segments subequal in length or the second longer than the first, each longer than any of the succeeding segments; segments six and seven globose, sides rounded.

*Prothorax*: Sides usually distinctly rounded with a constriction just before apex, sometimes subparallel behind apical constriction; dense punctures frequently confluent; disc with a usually fine, median, longitudinal carina from base to apex, sometimes evanescent sub-basally; sparsely covered with pale tan, reddish-yellow, brownish, pale white, or white elongate (some tapering) recumbent to subrecumbent setae; color of setae varying greatly; frequently a few, sometimes many, setae erect.

*Elytra*: Approximately one-fourth longer than wide; sides subparallel for over half, then converging to the apex; basal border only feebly emarginate before the humeri, which are obliquely rounded and not prominent; intervals 3, 5, 7, and 9 feebly and acutely costate, costae sometimes quite distinct, costa of interval 3 frequently flattening out on apical declivity; males usually with intervals 1 and 2 as distinctly or more costate than intervals 3, 5, 7, and 9; costae extending from base to apical declivity, that of interval 2 sometimes evanescent sub-basally or feebly interrupted in places, these costae rarely absent; females with interval 1 frequently costate and sometimes with interval 2 feebly and irregularly costate; costa of interval 2 never as distinct in female as in male; serial punctures large, closely-set, and quadrate; elytra with a sparse covering of reddish-yellow, pale tan, and white elongate and tapering recumbent setae; white setae condensed in a few scattered patches, but chiefly in a narrow, posteriorly curved, postmedian band, the distinctness of which is variable; sometimes also forming a conspicuous spot at base of third interval, sometimes absent; the other colored setae scattered over surface; sometimes the lighter ones are aggregated in patches here and there; elytra sometimes bare in spots, the vestiture then giving them a mottled appearance; each interval with a usually conspicuous row of pale tan, amber, or white, blunt-tipped, suberect setae.

*Ventral surface:* Mesosternum usually with a distinct emargination anteriorly. Abdominal sterna densely and coarsely punctate; fifth sternum sometimes finer and more densely punctate than preceding sterna, without tubercles and with or without a median depression; sparse vestiture of tan, amber, and reddish-yellow, recumbent and sub-erect setae, the latter sometimes giving the venter a "bristly" appearance.

*Legs:* Mesofemoral tooth occasionally obsolete; sparse to moderately dense vestiture of reddish-yellow, light tan, grayish, and white elongate and tapering setae.

*Male genitalia:* (Figs. 60 and 87). Aedeagus twice as long as wide and twice as long as aedeagal struts; sides gradually converging on apical third to form at apex a distinct acute process; basal portion of inner curvature not as distinct as it is apically; dorsal membrane V-shaped apically; transfer apparatus consisting of a complex of bars similar to that of *naso* Lec., the elongate lateral pair most evident and protruding into prephallotremic area; laterally, apical process hooked. Length .875-.937 mm., width at base .413-.449 mm., aedeagal struts .375-.399 mm.

*Type locality:* Florida.

*Type:* Boheman Collection, Stockholm Museum, Stockholm, Sweden.

*Distribution:* "Ranges from Ontario and New England to Wisconsin and Iowa, south to Florida," Blatchley and Leng (1916). Champion (1904, p. 404) recorded it from Mexico, Guatemala, and Panama, but stated that Central American examples were slightly different from those of the United States. Range extended to Texas. Records from: Alabama, District of Columbia, Florida, Georgia, Illinois, Indiana, Iowa, Kansas, Louisiana, Maryland, Massachusetts, Michigan, Mississippi, Missouri, New Hampshire, New Jersey, North Carolina, New York, Ohio, Oklahoma, Ontario, Pennsylvania, Rhode Island, South Carolina, Tennessee, Texas, Virginia, and West Virginia.

*Biology:* Literature records of this species are scarce, and those available are not in agreement. Hamilton (1895) records *posticatus* Boh. as commonly bred from the fruits of *Crataegus*, while Pierce (1907a), quoting E. A. Schwarz, states that the larvae dwell in galls of certain *Phylloxera* on hickory leaves, the *Phylloxera* probably perishing from starvation. Pierce (1907b) reports breeding this species from prematurely fallen hickory nuts collected on June 8 at Logansport, La. He states, "The larvae clean out practically the entire nut and then enter the ground for pupation." Brooks (1910) reared *posticatus* Boh. from chestnut oak acorns, and in his report quotes Webster as breeding it from white oak acorns. Blatchley and Leng (1916) record beating this species from the blossoms of wild plum, while Wellhouse (1922) lists its hosts as *Crataegus*, *Prunus*, and *Carya*.

The specimen records are as follows: "in *Q. alba*" (Colmanville, Pa., F. C. Pratt); "*Q. pedunculata* and *Q. rubra*" (District of Columbia); "*Q. durandii*" (Victoria, Texas, J. D. Mitchell); "in open chestnut bur" (Framingham, Mass., C. A. Frost); "hibernating beneath leaves of *Q. alba*, *coccinea*, *palustris*, *velutina*, and *borealis* var. *maxima*" (Wortendyke, N. J., H. F. Schoof).

The majority of the records indicate that *posticatus* Boh. probably breeds in acorns of various species of *Quercus*. Whether hickory nuts and Phylloxera galls also serve as hosts cannot be definitely determined. The record from Phylloxera galls on hickory appears more like the work of *elegans* (Say), while that from hickory nuts could well apply to *affinis* Boh. As both of these species belong to Group I (the two-toothed femur group), it does not seem likely that the specimens from which these records were taken were misidentified. Nevertheless, it would appear that until corroborative data are obtained, the records from hickory nuts and Phylloxera galls should be considered questionable. Hamilton's (1895) record of *Crataegus* as a host likewise is questionable.

Brooks (1910) states that the life-history of *posticatus* Boh. at French Creek, West Virginia, is similar to that of *naso*, Lec. On this basis the larva is the overwintering stage, with the adult appearing in June, July, and August. The writer, however, has found adults of this species hibernating beneath oak leaves on December 26 to 29 in New Jersey, which indicates a somewhat different life cycle than that reported by Brooks (1910). From the biological data available, it appears that there is need for a more careful study of the life history and host plants of this species.

Specimen records show that *posticatus* Boh. has been attracted to light traps and in one instance to a molasses trap.

*Remarks:* The relationships of this species have been briefly mentioned under *C. naso* Lec. Champion (1904) mentions a variety having the first and second intervals costate, but this is more a sex character of the males.

#### *Conotrachelus recessus* (Casey)

*Loepletes recessus* Casey, 1910, Can. Ent., 42, p. 130.

*Conotrachelus atokanus* Fall, 1913, Trans. Amer. Ent. Soc., 39, p. 65.

*Length:* 2.5-3.0 mm.

*Special characters:* First funicular segment of antenna subequal in length to the next two combined.

*Color:* Elytra chiefly reddish-brown with a little black; prothorax piceous.

*Head:* Densely punctate and thickly covered with broad, light tan,



recumbent scales, truncate at the tip; a few pale elongate setae also present; beak feebly curved, but distinctly straight in female below antennal insertion; subequal in length to prothorax and slightly longer in female; feebly sulcate laterally; lower sulcus distinct; median sulcus evanescent basally; upper sulcus replaced by punctures; dorsal surface non-carinate; distad of antennal insertion with dense elongate punctures in male; punctuation finer and indistinct in female; vestiture of truncate-tipped scales and elongate setae, light tan setae denser basally; antennae inserted approximately one-third from apex in male, one-half in female.

*Prothorax:* Sides either subparallel or feebly rounded from base to near apex, then constricted; disc with dense, medium-sized, shallow punctures; non-carinate and without tubercles; densely clothed with a mixture of broad, truncate-tipped, recumbent, tan and white scales, the tan scales predominant, the white ones along the sides condensed in small spots at the basal angles; elongate, recurved, brown, tan, and white setae sparsely interspersed among scales, vestiture usually obscuring punctuation.

*Elytra:* One-third longer than wide; sides subparallel for about two-thirds, then gradually converging to the apex; basal border feebly emarginate mesad of humeri; the latter not prominent, rounded; intervals 3, 5, and 7 feebly convex but not costate; serial punctures small, obscured by the vestiture; dense vestiture of oblong tan (golden) and white scales, the golden scales greatly predominant, the white scales aggregated basally at the humeri and the third intervals and sparsely scattered medially at the apical declivity and between the middle and the base; each interval with a row of elongate, recurved, pale, white, and dark brown setae which are most abundant and evident on convex intervals, especially basally.

*Ventral surface:* Mesosternum not protuberant, sloping anteriorly. Abdominal sterna coarsely and densely punctate; punctures of sterna 1 and 2 larger than those of the succeeding sterna; sternum 5 without tubercles or depressions; each puncture with a light tan or white seta; setae along the sides broader and forming patches.

*Legs:* Femoral tooth distinct; unci not dentate in either sex, in male tapering and usually acute, in female stubby and bluntly rounded at apex; legs with a moderately dense vestiture of recumbent tan and white setae; femora with a few pale scales mixed among the apical setae.

*Male genitalia:* (Figs. 63 and 90). Aedeagus elongate, three times as long as wide at base and four times the length of the aedeagal struts; sides bisinuate; apex without a process; dorsal membrane narrowed for approximately the median half and then expanded both basally and apically; apical border broadly curved; dorsal area possibly sclerotized;

transfer apparatus protruding into prephallotremic area. Length .500 mm., width at base .165 mm., aedeagal struts .125 mm.

*Type locality:* Atoka, Oklahoma.

*Type:* Male, Wickham, T. L. Casey Collection (USNM).

*Type:* Male, *atokanus* Fall: Museum of Comparative Zoology Type No. 25228, Atoka, Indian Territory, June 13-15, Wickham (MCZ).

*Distribution:* Ranges from Iowa to Oklahoma, Arkansas, and Texas. Records from: Arkansas, Iowa, Kansas, Oklahoma, and eastern Texas.

*Biology:* Five specimen records, each indicating a different host plant, furnish the only biological data available for *recessus* (Csy.): "peaches" (Bonham, Texas, E. and G. Wheeler); "*Quercus minor*" (Clarksville, Texas, E. S. Tucker); "box elder" (Dallas, Texas, W. D. Pierce); "on *A. cannabinum* L. var. *pubescens*" (W. E. Hoffman); and "on *Maclura pomifera* (Osage Orange)" (Dallas, Texas, W. D. Pierce).

This species has also been collected "at lights" in Fayetteville, Arkansas.

*Remarks:* This small species was originally described by Casey (1910) who placed it in the Tychiini as the type of the monobasic genus *Loceptes*. Fall (1913) correctly described the same species as *Conotrachelus atokanus*, and it was known under this name until Buchanan (1937) published the synonymy.

*C. recessus* (Csy.), by its small size, golden-colored scales, and re-curved elytral setae, can be readily distinguished from other species of *Conotrachelus*.

#### *Conotrachelus geminatus* Leconte

*Conotrachelus geminatus* Leconte, 1876, Rhynchophora N. A., Proc. Amer. Philos. Soc., XV, No. 96, p. 232; Dejean, 1837, Cat. Col., Paris, p. 322, *n.n.*; Blatchley and Leng, 1916, Rhynchophora N. E. Amer., p. 478; Mutchler and Weiss, 1925, Conotr. N. J., Circ. 87, Bur. Stat. and Insp., Dept. Agr., N. J., p. 21.

*Length:* 3.85-4.85 mm.

*Special characters:* Setae of median portion of abdominal sterna 2 to 5 short, scarcely visible; femoral tooth not acute and usually feeble.

*Color:* Elytra reddish and prominently splotted with black; black sometimes predominant.

*Head:* Densely punctate; a short pale seta arising from each puncture; beak stout, curved either feebly or distinctly, curvature sometimes more abrupt apically; subequal in length to prothorax and in both sexes; occasionally trisulcate laterally between base and antennal insertion; upper or median sulcus, or both, however, frequently feeble and obscure; lower sulcus always distinct; sulci, when absent, replaced by dense punc-

tures, which give the area a distinctly roughened appearance; dorsal surface occasionally carinate to near or distad of middle, but usually non-carinate; apical tip distad of antennal insertion with fine, elongate punctures dorsally; punctures moderately dense to dense, usually sparse in the female, and sometimes obscure; lateral area proximad of antennal insertion sparsely set with pale tan setae; antennae inserted one-fourth to one-third before apex; first two funicular segments subequal in length and each longer than any of the others.

*Prothorax*: Sides subparallel or parallel to just before apex, then sharply constricted; sometimes gradually rounded from base to apex, outline sometimes varying in form on different sides in the same specimen; with dense coarse reticulate punctures, deep and usually not confluent, but occasionally a few confluent apically; non-carinate and without tubercles; each puncture with a suberect pale tan or amber seta; sometimes a tiny patch of white oblong subrecumbent setae on the lateral median border of the disc.

*Elytra*: Approximately one-third longer than wide; sides subparallel for over half, then sharply converging to the apex; basal border emarginate before the humeri; the latter varying in prominence, obliquely rounded; intervals 3 and 5 sometimes convex but not costate, at the most with feeble, broad elevations apically; intervals 7 and 9 sometimes feebly to moderately costate, especially basally; serial punctures coarse; very sparse vestiture of tan, pale tan, silvery, and white recumbent setae, the white setae aggregated into small scattered patches among the predominantly tan and pale tan setae which, plus the variegated color markings of the elytra, give the wing covers a very mottled appearance; or more abundant apically along intervals 3 and 5; above setal arrangement variable; occasionally pale white setae predominate; numerous areas bare; intervals set with rows of suberect pale and dark tan setae, usually distinct but sometimes scarcely noticeable.

*Ventral surface*: Mesosternum not protuberant, with a slight slope basally. Abdominal sterna moderately to coarsely punctate; sternum 1 usually less densely and more coarsely punctate than 2; sternum 5 usually more densely punctate than 2, 3, and 4; punctures of sterna 3 and 4 sometimes fine and sparse; punctuation of all sterna varies greatly in density, so that digressions from above pattern are frequent; sternum 5 without tubercles, with a distinct median depression in the female, at most feebly depressed in male; each puncture with a short, scarcely visible, pale amber seta, these setae occasionally replaced by longer white or tan setae, particularly on sternum 1 and laterally on 2, 3, and 4.

*Legs*: Metaunci not dentate in either sex; legs sparsely clothed with pale tan, tan, and white setae.



*Male genitalia:* (Figs. 61 and 88). Aedeagus twice as long as wide at base, and two to two and one-half times as long as aedeagal struts; outer curvature bisinuate; basal portion of inner curvature difficult to detect; apex with a broad, blunt process; dorsal membrane very small, V-shaped apically, but edge difficult to detect; transfer apparatus consisting of a pair of semicircular bars; laterally, aedeagus highly arched, dorsal and ventral curvatures gradually approaching apically. Length .812-.875 mm., width at base .336-.399 mm., aedeagal struts .262-.375 mm.

*Type locality:* Leconte (1876) at the time of his description of *geminatus* had before him specimens from Illinois, Kansas, and Maryland. Of the two specimens now in the Leconte Collection, one bears a pink disc indicating Leconte's symbol for "Middle States," the other a green disc, probably referring to Nebraska. The author has interpreted Leconte's term "Middle States" as including Maryland, thereby making this specimen available as a lectotype.

*Lectotype*, hereby designated: The specimen labelled "*geminatus* + Dej." and bearing a pink disc in the J. L. Leconte Collection (MCZ).

*Distribution:* "Ranges from Quebec and New England to Iowa and Kansas, south to Florida," Blatchley and Leng (1916). Range extended west to Nebraska. Records from: District of Columbia, Illinois, Indiana, Iowa, Kentucky, Maryland, Massachusetts, Michigan, Missouri, Nebraska, New Jersey, New York, North Carolina, Ohio, Pennsylvania, and Virginia.

*Biology:* Specimen records show that *C. geminatus* Lec. has been bred from the flower heads of *Bidens* (beggar-tick) at Rosslyn, Virginia, by A. N. Caudell, and from the fertile flowers of the giant ragweed at Kinderhook, Illinois, by L. Hack. Pierce (1907a) records the species on *Ambrosia trifida*. These are the only definite host records for this species.

Other specimen data are: "*Carex frankii*" (W. Point, Indiana) and "trap lantern" (Lafayette, Indiana).

*Remarks:* Leconte (1876) and Blatchley and Leng (1916) considered Dejean (1837) as the author of the name *geminatus* but Dejean's *geminatus* is a *nomen nudum*. Therefore, Leconte (1876), being the first to describe the species, is the author of the species. Mutchler and Weiss (1925) and Hustache (1936) correctly designated the species *geminatus* Lec.

Leconte (1876) and Hustache (1936) both list *C. puncticollis* Walsh as a synonym of *geminatus* Lec., but this species from its description appears to be a synonym of *cribricollis* (Say) rather than *geminatus* Lec. A discussion of this synonymy is given under *cribricollis* (Say) on page 117.

*Conotrachelus cribricollis* (Say)

*Cryptorhynchus cribricollis* Say, 1831, Desc. N. A. Curc., New Harmony, Indiana, p. 28, in Writings of Thomas Say, ed. Leconte, 1859, p. 296.

*Conotrachelus cribricollis* (Say) Boheman, 1837, Schönh. Gen. Spec. Curc., IV, pt. 1, p. 446; Leconte and Horn, 1876, Rhynchophora N. A., Proc. Amer. Philos. Soc., XV, No. 96, p. 233; Blatchley and Leng, 1916, Rhynchophora N. E. Amer., p. 479; Mutchler and Weiss, 1925, Conotr. N. J., Circ. 87, Bur. Stat. and Insp., Dept. Agr., N. J., p. 21.

*Conotrachelus puncticollis* Walsh, 1864, Proc. Bost. Soc. Nat. Hist., IX, p. 310, pre-occupied by *puncticollis* Fahreus, 1837, Schönh. Gen. Spec. Curc. IV, pt. 1, p. 405 (see Col. Cat., Junk and Schenkling, Pars 151, 1936, p. 26) (new synonymy).

*Length:* 3.80-4.85 mm.

*Special characters:* Undersurface of apical portion of beak (viewed laterally) with prominent, usually long, suberect and erect amber setae; elytra with a "bristly" appearance; many setae of median portion of abdominal sterna 2 to 5 long and conspicuous; femoral tooth prominent and acute, usually a minute denticle distad of tooth.

*Color:* Prothorax and elytra piceous to black.

*Head:* Densely punctate; with a sparse to moderately dense covering of tan and white recumbent setae; beak stout, curved, usually abruptly bent apically near antennal insertion; shorter than prothorax, equal in length in both sexes; distinctly trisulcate laterally between base and antennal insertion; dorsal and median sulci often replaced basally by dense punctures; median sulcus distinct and broad apically; dorsal surface finely and acutely carinate from base to distad of middle; surface distad of antennae with coarse, elongate punctures, moderately dense to dense; sparse to moderately dense vestiture of tan and white setae which are denser basally; antennae inserted approximately one-fourth to one-third before tip; first two funicular segments subequal in length and each longer than any of the other segments.

*Prothorax:* Feebly rounded from base to apex or subparallel to one-fourth before apex, then constricted; very coarsely and deeply punctured (foveate); no areas between punctures other than their walls; depth of discal punctures approximately one-fourth to one-half their diameters; punctures frequently confluent, forming longitudinal ridges; each puncture with a prominent brown or tan erect seta.

*Elytra:* Approximately one-third longer than wide; sides subparallel for more than half, then gradually converging to the apex; basal border not or but feebly emarginate before humeri; the latter not prominent and obliquely rounded; intervals feebly convex but not costate, more convex apically; serial punctures large, deep, quadrate, and closely set; with a moderately dense, variegated vestiture of light tan, brownish, and white recumbent setae; the white setae in scattered patches over the surface,

and condensed with light tan setae on the humeri and at base of interval 3; each interval set with a prominent row of long, suberect, tan, brown, and white setae which give the elytra a "bristly" appearance.

*Ventral surface:* Mesosternum not protuberant, or only slightly so. Abdominal sterna with large, deep, dense, reticulate punctures; fifth sternum without tubercles or depressions; each puncture with a subrecumbent or suberect pale tan or amber seta; suberect setae conspicuous and much longer than subrecumbent ones; a few lateral subrecumbent setae white.

*Legs:* Metaunci in male short and blunt at apex, in female acute; legs with a sparse vestiture of tan, brown, and white recumbent to suberect setae, the latter chiefly on the tibiae.

*Male genitalia:* (Figs. 62 and 89). Aedeagus approximately twice as long as wide at base and twice as long as aedeagal struts; sides bisinuate sometimes feebly so, and widened to obtuse points at the apex; the latter broad and with a feeble rounded process; dorsal membrane small, sometimes extending farther basally than in Fig. 62; apical border broadly U-shaped; transfer apparatus consisting of a pair of prominent dorsal semicircular bars and two lateral pairs, the latter with one bar above the other. Length .687-.738 mm., width at base .336-.363 mm., aedeagal struts .274-.336 mm.

*Neotype locality:* Urbana, Illinois. Say's type locality: Mississippi.

*Neotype:* Male, June 14, 1940, H. B. Petty, light trap (HFS).

*Neotype:* Female, Havana, Illinois; June 20, 1928; T.H.F. and H.H.R. (ISNHS).

*Neoparatypes:* ALABAMA: Mobile Co., H. P. Loding, 2 ♂, (USNM); Mobile, April 18, 1910, on *Pinus palustris*, W. D. Pierce, ♀, (USNM); ILLINOIS: Urbana, April 7, 1889, Ac. No. 25014, C. A. Hart, ♂, (ISNHS); Galesburg, ♂, (ISNHS); Dubois, Ac. No. 16058, A. A. Hinkley, ♂, (ISNHS); Golconda, May 30, 1928, at light, T. H. Frison, 2 ♀, (ISNHS); Pegrim, May 27, 1903, Ac. No. 34389, Titus, ♀, (ISNHS); Grand Tower, June 2, 1913, in woods at night, ♀, (ISNHS); Urbana, April 15, 1939, hibernating at edge Brownfield Woods, H. F. Schoof, 2 ♀, (HFS); IOWA: Lee County, July 6, 1925, Rockenbach, ♀, (WPH); Ames, July 13, D. Stoner, ♂, (USNM); KANSAS: Topeka, March 15, ♂, (USNM); KENTUCKY: Lexington, November 24, 1894, No. 1912, ♀, (HFS); LOUISIANA: Bayou Sara, January 24, 1879, ♂, (USNM); MARYLAND: Plum Point, May 28, 1922, L. L. Buchanan, ♀, (USNM); MISSISSIPPI: Jackson, April 6, 1912, A. A. Green, S. 3308, ♂, ♀, (HFS); Cleveland, May 24, 1915, J. S. Wakefield, S. 4024, 2 ♀, (USNM); Jackson, Oct. 1906, W. M. Bamberger, ♀, (USNM); West



Point, August 12, H. S. Barber, ♀, (USNM); West Mississippi, July 27, 1912, J. M. Johnson, ♀, (USNM); Scooba, S. 3643, R. Stuart, ♀, (USNM); Skene, April 24, 1911, G. Janoush, S. 3053, ♀, (USNM); MISSOURI: Columbia, July 14, 1905, ♀, (U Mo); Columbia, August 29, 1924, E. T. Jones, ♀, (HFS); NORTH CAROLINA: Southern Pines, January 6, 1909, A. H. Manee, Nason Collection, ♀, (UIDE); Garner, December 4, 1940, hibernating in hedgerow, ♀, W. A. Majure, (HFS); PENNSYLVANIA: Allegheny Co., ♀, (USNM); SOUTH CAROLINA: Clemson College, May 9, 1930, D. Dunavan, ♀, (USNM); TENNESSEE: Memphis, March 12, 1893, H. Soltau, ♀, (USNM); TEXAS: Devil's River, June 5, 1907, E. A. Schwarz, ♀, (USNM), Devil's River, May 6, 1907, at light, Bishopp and Pratt, ♂, (HFS), ♂, (USNM); VIRGINIA: ♂, (USNM).

*Distribution:* "Ranges from New England to Northern Illinois, south to Louisiana and Texas," Blatchley and Leng (1916). Range extended west to Kansas and Nebraska and southeast to Alabama and Florida. Records from: Alabama, Arkansas, Florida, Illinois, Indiana, Iowa, Kansas, Kentucky, Louisiana, Maryland, Missouri, Mississippi, Nebraska, North Carolina, Ohio, Pennsylvania, South Carolina, Tennessee, Texas and Virginia.

*Biology:* Other than the following few specimen records there is no biological information available on this species. "On *Pinus palustris*" (Mobile, La., W. D. Pierce); "on Ambrosia" (Central Mo., C. V. Riley); "in cotton fields" (Paris, Texas, F. C. Bishopp); "on cotton" (Valdosta, Ga., W. L. Lowry); "jarred from peach" (Fort Valley, Ga., O. I. Snapp); "hibernating under leaves at edge of woods" (Urbana, Ill., H. F. Schoof); "hibernating under pokeweed, blackberry, aster, and other weeds" (Garner, N. C., W. A. Majure); "collected in weeds, trash" (Florence, S. C., C. F. Rainwater); and "at light" (Devil's River, Texas, Bishopp and Pratt, and Riley County, Kansas, P. J. Parrot).

*Remarks:* This species, in contrast to *retentus* (Say) and *elegans* (Say), has not been the source of much confusion. It is easily distinguished from other species of *Conotrachelus* by its widely and deeply punctate (foveate) prothorax and by the numerous suberect setae which give the elytra a "bristly" appearance. The chief difficulty encountered with the identification of *cribricollis* (Say) arises from the usual occurrence of a minute denticle distad of the femoral tooth. According to the grouping of this genus, this species should belong to Group I which is characterized by having two femoral teeth. However, *cribricollis* (Say) bears little affinity to any of the species in that group excepting possibly *nivosus* Lec. which, as previously mentioned, is also unrelated to most of the species included therein. Just what the relationships of these two

"misfits" are, cannot be stated at this time. With the material on hand the only congruous statement that can be made is that both species appear to be intergrades between Groups I and II. *C. cribricollis* (Say) has been placed in the one-toothed group because the denticle is sometimes absent and because when it is present the specimen is usually considered one-toothed, since the denticle is often so minute that it is overlooked.

*C. puncticollis* Walsh (1864) is listed here as a synonym of *cribricollis* (Say), although it has been considered by Leconte (1876), Leng (1920), and Hustache (1936) as a synonym of *geminatus* Lec. As the type specimen of *puncticollis* Walsh (1864) has apparently been lost, this synonymy has been based entirely on Walsh's original description which is given below:

"*Conotrachelus puncticollis*, n. sp.—Head black with a coppery lustre, finely pubescent, with very fine confluent punctures; rostrum suddenly bent inwards at two-thirds the distance to its tip, as in *C. anaglypticus* Say. Thorax black, sparsely pubescent, much narrower than the elytra, as wide as long, scarcely contracted at its base, but much contracted at its tips, with very large deep punctures confluent above, so as to form towards its tips three or four irregular longitudinal carinae. Elytra regularly punctate-striate, without any carinae, the striae shallow and wide, the punctures moderate; the interstices flattish, very finely punctured, and with a row of short cinereous bristles upon each directed backward; the whole elytram irregularly mottled with whitish and brown, so as to appear gray, with 3 or 4 indistinct brown fasciae, except on the base of the third interstice, where there is a conspicuous short, whitish vitta. Legs blackish with fine short whitish pubescence, the second tooth of the femora obsolete. Length  $\frac{3}{20}$ th inch. One specimen. Near *C. cribricollis*, Say, but that species has the elytra black without any bristles. Except in the comparative shortness of the thorax, it resembles in its shape *C. anaglypticus*, Say, and is much broader than *C. nenuphar* the 'curculio.'"

In this description it will be noted that the thorax (prothorax) is characterized as having very large, deep punctures which are confluent above, so as to form towards its tip three or four longitudinal carinae. This character is similar to that found in *cribricollis* (Say), but differs from that of *geminatus* Lec. where the prothoracic punctures never form longitudinal ridges. The remainder of the description can be applied equally well to both *cribricollis* (Say) and *geminatus* Lec. The beak in *cribricollis* (Say) usually is abruptly bent at the apical third, but *geminatus* Lec. sometimes also has the beak similarly shaped apically. Because the description of the prothoracic punctation of *puncticollis* Walsh fits *cribricollis* (Say) and not *geminatus* Lec., the first two of these names are here considered synonyms.

As will be noted, Walsh states in his description that *cribricollis* (Say) does not have elytral bristles. This statement is confusing, since *cribricollis* (Say) definitely does have erect elytral setae (bristles). At that time (1864), the only available description of *cribricollis* was the one published by Say (1831) which stated that the body had numerous very short hairs, but did not mention whether or not the hairs were erect. Say described the prothorax as having the whole surface covered by large concave punctures, without any very flat space between them, so that it is concluded that he had before him the species which has been interpreted as *cribricollis* (Say) by Leconte (1876), Blatchley and Leng (1916), and others, as well as by the present writer. Just which species Walsh was referring to as *cribricollis* (Say) is not at all clear. Possibly the erect bristles had been rubbed off in the specimen of *cribricollis* (Say) that Walsh had before him.

*C. puncticollis* dates from Walsh in 1864 and not 1863. As with *C. crataegi* Walsh, the original description of the species was published in the Proceedings of the Boston Society of Natural History for the year 1863, but the actual date of publication was March, 1864 (*loc. cit.*, bottom of page 305). Walsh's description was also published in *Prairie Farmer*, n. s., Vol. 12, No. 2, July 11, 1863, p. 21; but as this agricultural journal is not a technical publication, this earlier description is invalid.

### GROUP III

This group corresponds to Group II of Leconte and Horn (1876) and to Group IV of Blatchley and Leng (1910). It consists of five species. Three of them, *tuberosus* Lec., *anaglypticus* (Say), and *leucophaeatus* Fahr., occur in the midwestern region. The other two species, *obesulus* Hust. and *coronatus* Lec., are rare and have been found only in the southeastern states. All species agree in having the prothorax with a dorsal, median, longitudinal furrow, thus being readily separated from other species of *Conotrachelus*. In addition, the species in this area have the beak subequal to or shorter than the prothorax; first funicular segment of antennae subequal to or longer than second, each longer than any succeeding segment; prothorax densely and usually coarsely punctate, clothed laterally with two lines of white or tannish vestiture; elytral intervals 3, 5, 7, and 9 costate; costa of interval 5 always interrupted subbasally; elytral vestiture chiefly of recumbent setae; mesoscutellum from lateral aspect abruptly declivent basally; metasternum in male never grooved from meso- to metacoxa; abdomen coarsely punctate; femora with a tooth and usually a small denticle; aedeagus elongate with a dorsal membrane and an apical process; transfer apparatus a complex of sclerotized bars.



Group III is known as the "*anaglypticus* group," and this designation in contrast to those of Groups I and II typifies the group, all species being quite similar in habitus and closely related.

## KEY TO SPECIES OF GROUP III

1. Costa of interval 3 strongly interrupted twice (anterior interruption occasionally feeble) to form three elevations, the median and posterior ones abrupt and prominent; aedeagus with apical process pointed (Fig. 66), length 2.5-3.0 mm. .... *tuberosus* Leconte, p. 119
- 1- Costa of interval 3 sometimes feebly interrupted anteriorly, rarely interrupted twice; if so, elevations formed are not prominent; and specimens are 4.0-5.5 mm. with elytral vestiture conspicuously white; aedeagus with apical process rounded (Figs. 67 and 68) ..... 2
2. Elytral vestiture usually not conspicuously white; if so, the white transverse band is always behind the subbasal interruption of costa of interval 5; each elytron with an oblique bar of yellowish vestiture just behind the humerus; bar usually prominent, sometimes faint, but always evident; male metatibia deeply emarginate before uncus (Fig. 32a); aedeagus as shown in Fig. 67 ..... *anaglypticus* (Say), p. 121
- 2- Elytral vestiture conspicuously white, with a broad transverse white band extending from apical declivity to posterior edge of humerus; elytron never with an oblique yellowish bar behind humerus; male metatibia not emarginate before uncus; aedeagus as shown in Fig. 68 ..... *leucophaeatus* Fahreus, p. 126

*Conotrachelus tuberosus* Leconte

*Conotrachelus tuberosus* Leconte, 1876, Rhynchophora N. A., Proc. Amer. Philos. Soc., XV, No. 96, p. 233; Blatchley and Leng, 1916, Rhynchophora N. E. Amer., p. 480.

*Length:* 2.5-3.0 mm.

*Special characters:* Beak quadrisulcate laterally; eyes not contiguous beneath; interocular distance equal to or more than length of first funicular segment of antenna; median elevation of elytral interval 3 hump-like.

*Color:* Elytra and prothorax dark brown or black.

*Head:* Densely punctate, punctures larger apically; densely rugulose; bare; the punctures with fine, brown, inconspicuous setae; beak stout, feebly curved to near the antennal insertion, then abruptly bent; shorter than prothorax, equal in length in both sexes; quadrisulcate laterally between base and antennal insertion, the usual single lower sulcus definitely divided; dorsal surface distinctly carinate from base to distad of middle, usually acutely; apical tip distad of carina with moderately dense to dense elongate punctures; densely rugulose; sulci sparsely set with reddish-yellow, tan, and white setae; antennae inserted approximately one fourth from apex; first funicular segment stouter than second.

*Prothorax:* Sides slightly widening from base to approximately one-

third before apex, then constricted; densely and coarsely punctate; ridges bordering median furrow variable in distinctness; usually not carinate medianly; occasionally a feeble, median, longitudinal ridge behind median furrow; densely rugulose; each puncture with a brown, tan, or white subrecumbent or suberect seta; setae variable in length; vestiture densest and most prominent along each side where white setae are condensed to form two lines, one sinuate and extending diagonally from basal angle to postocular lobe, the other usually extending from just within basal angle apically to about the middle, these two lines united apically by an oblique line; lines of white vestiture sometimes obscure.

*Elytra:* Three-fourths to four-fifths as wide as long; sides subparallel for more than half, then abruptly converging to apex; basal border feebly emarginate before humeri; the latter not prominent and rounded; intervals 3 and 5 costate; costa of interval 3 usually strongly interrupted twice to form three hump-like elevations; median elevation longer and more prominent than either of the other two; anterior elevation and anterior interruption sometimes feeble; costa of interval 5 usually similarly interrupted, sometimes complete posteriorly; median and posterior elevations never as prominent as respective ones of interval 3, sometimes small and widely separated; interval 7 usually with a feeble costa, interrupted once basally; interval 9 usually feebly costate from before base to apex; serial punctures close-set, coarse; punctures so coarse and close that sometimes intervals almost obliterated; with a sparse vestiture of reddish-yellow, tan, and white setae; setae prominently condensed at base of interval 3, also more abundant between median and posterior elevations of interval 3.

*Ventral surface:* Mesosternum angulate on anterior border, feebly protuberant. Abdominal sterna with large, coarse, dense punctures; surface densely rugulose; sternum 5 not tuberculate or depressed; each puncture with a brown, tan, or white seta, variable in length.

*Legs:* Femora with a large conspicuous tooth; a small denticle sometimes also present; profemora only with a distinct anterior bulge opposite tooth; metanotum not dentate in either sex; femoral area distad of tooth with a moderately dense to dense vestiture of recumbent and subrecumbent white and tan setae, metafemoral vestiture denser; femoral area proximad of tooth with sparse vestiture.

*Male genitalia:* (Figs. 66 and 93). Aedeagus two and one-half times as long as wide, and two and one-half times the length of the aedeagal struts; sides slightly constricted medially and gradually converging apically to form a distinct, pointed process; dorsal membrane V-shaped apically; transfer apparatus with a pair of bars J-shaped, a second pair straight, the latter beneath and extending obliquely across the inner angle

of J-shaped bars; apparatus projecting into prephallotremic area. Length .649-.687 mm., width at base .238-.250 mm., aedeagal struts .250 mm.

*Type locality:* Illinois.

*Lectotype*, hereby designated: Museum of Comparative Zoology Type No. 5221-2, J. L. Leconte Collection (MCZ).

*Lectoparatypes:* Museum of Comparative Zoology Type No. 5221-3, Illinois, J. L. Leconte Collection (MCZ); Museum of Comparative Zoology Type No. 5221-1, no locality, J. L. Leconte Collection (MCZ).

*Distribution:* Ranges from District of Columbia to Iowa south to Louisiana. Records from: Alabama, District of Columbia, Illinois, Iowa, Indiana, Maryland, Ohio, and Virginia.

*Biology:* Ulke (1902) records *tuberosus* Lec. as occurring on *Urtica*, and Blatchley (1922) reports the same host, stating that for two summers numerous specimens of *tuberosus* Lec. were swept from nettles (*Urtica*) in dense woodlands in Marion County, Indiana. No other data are available.

*Remarks:* *C. tuberosus* Lec. resembles those species of Group I in which the elytral costae are abruptly interrupted to form distinct elevations. Its prothoracic sculpture and its male genitalia, however, clearly indicate its placement in Group III. Other than the costal interruptions of the elytra it is quite similar to *anaglypticus* (Say) of this group.

### *Conotrachelus anaglypticus* (Say)

*Cryptorhynchus anaglypticus* Say, 1831, Desc. N. A. Curc. New Harmony, Indiana, p. 18, in Writings of Thomas Say, ed. Leconte, 1859, p. 282.

*Conotrachelus anaglypticus* (Say) Fahreus, 1837, Schönh. Gen. Spec. Curc. IV, pt. 1, p. 418; Leconte and Horn, 1876, Rhynchophora N. A., Proc. Amer. Philos. Soc., XV, No. 96, p. 234; Champion, 1904, Biol. Cent. Amer., IV, pt. 4, p. 420; Blatchley and Leng, 1916, Rhynchophora N. E. Amer., p. 480; Mutchler and Weiss, 1925, Conotr. N. J., Circ. 87, Bur. Stat. and Insp., Dept. Agr., N. J., p. 19.

*Conotrachelus rubiginosus* Boheman, 1845, Schönh. Gen. Spec. Curc. VIII, pt. 2, p. 28.

*Length:* 2.95-4.66 mm. (usually 3.7-4.3 mm.).

*Special characters:* Eyes contiguous beneath or nearly so; interocular space not greater than twice the diameter of a facet; median longitudinal furrow of prothorax usually feeble, sometimes scarcely evident; elytral costae of intervals 3, 7, and 9 usually acute and complete.

*Color:* Elytra light reddish-brown to piceous mixed with black; prothorax dark piceous to black.

*Head:* Densely punctate, rugulose, sparsely covered with recumbent brownish-yellow and white setae; beak feebly curved, curvature usually abrupt near the antennal insertion; subequal to or shorter than prothorax;



equal in length in both sexes; deeply trisulcate laterally between base and antennal insertion, median and upper sulci sometimes evanescent towards base; median sulcus sometimes with a cross-wall; lower sulcus occasionally divided; sulci punctate; dorsal surface with a distinct carina from base to distad of middle, extremely acute in male, sometimes barely extending beyond middle in female; apical tip distad of carina with dense, elongate punctures, so elongate as to form small sulci; lateral sulci sparsely set with tan, brownish-yellow, and white elongate setae; antennae inserted approximately one-third from apex in female, approximately one-fourth in male; first funicular segment stouter than second.

*Prothorax*: Subequal in length and width; sides subparallel to near apex, then narrowed; furrow sometimes narrowed apically; a conspicuous tubercle sometimes at posterior termination of each ridge bordering furrow; with dense, moderately coarse, uneven punctures; disc occasionally with a feeble median longitudinal carina extending from in front of middle to before base; carina entering basal third or fourth of median furrow, rarely prominent; two oblique, feeble to distinct, broad depressions on either side behind the middle; depressions approaching basally; when distinct, that edge proximad of base sometimes tuberculate basally; surface densely rugulose; sparse vestiture of tan, brown, and white, recumbent to suberect, frequently recurved setae; some setae much longer than others; the shorter white setae condensed into two prominent, lateral lines on each side; the lower line sinuate and extending from basal angle diagonally to postocular lobe; the upper line feebly curved, extending from inside of basal angle to before apex; lines united subapically by an oblique line; sometimes feeble additional branches also present.

*Elytra*: Approximately one-fourth longer than wide; sides subparallel for more than half, then converging to apex, or with a subbasal bulge followed by gradual convergence which is more abrupt beyond the middle; basal border feebly or not emarginate before the humeri; the latter not prominent, obliquely rounded; intervals 3, 5, 7, and 9 acutely costate; costa of interval 5 distinctly interrupted subbasally; that of 3 sometimes with a faint indication of an interruption opposite that of 5, usually complete; costae of intervals 7 and 9 occasionally feeble; that of 7 occasionally interrupted subbasally; striae marked by large coarse punctures (sometimes larger than those of prothorax); with a sparse to moderately dense vestiture of oblong white, yellow, and pale tan recumbent setae; yellowish setae usually condensed on basal half at humeri and intervals 3 and 5, and in a conspicuous oblique bar which extends from interval 7 through the subbasal interruption of costa of interval 5 to interval 3; yellow setae also in patches over elytra; white setae usually scattered over apical half and forming with the pale tan ones a

usually faint postmedian band; sometimes white setae predominate, replacing yellow setae in basal area (except in oblique bar), and forming a prominent broad postmedian band; the latter sometimes split into two or three narrow transverse bands; discal area between third intervals and apical declivity behind postmedian band with vestiture sparse; alternate intervals set with brown, tan, and white subrecumbent elongate setae, sometimes conspicuous on costate intervals where they are directed toward crest of costa.

*Ventral surface:* Mesosternum angulate anteriorly, protuberant; metasternum usually with a ridge from mesocoxa to metacoxa. Abdominal sterna 1, 2, and 5 with sparse to dense, deep punctures; sterna 3 and 4 usually less densely punctate than 1, 2, and 5; the latter sometimes with finer and denser punctures than sterna 1 and 2; relative denseness and coarseness of punctures varying greatly between 1, 2, and 5; surface densely rugulose; each puncture with a fine brown or amber seta; lateral setae broader and white, forming minute patches on sterna 3 and 4 and sometimes 2; sternum 1 sometimes with two patches of broader setae medially.

*Legs:* Profemoral tooth stouter than others; metafemora thicker than those anteriorly, especially in male; metatibia in male deeply emarginate before uncus; uncus large, compressed; in female metatibia similar to meso- and protibiae, uncus usually small and acute, sometimes short and truncate, never large and compressed; femora with vestiture (usually dense apically) of oblong and elongate, brown, tan, pale tan, and white setae, many scale-like, the white and tan ones predominant; femoral bands very conspicuous when setae are white.

*Male genitalia:* (Figs. 67 and 94). Aedeagus twice as long as wide at base, and twice the length of the aedeagal struts; sides sinuate and converging apically to form a distinct, broad, rounded process, the latter usually expanded as in Fig. 67, sometimes less so; inner curvature sometimes straight medially instead of indented as shown in Fig. 67; dorsal membrane difficult to detect, especially basally, with apical border V-shaped; transfer apparatus with the median J-shaped pair of bars bordered beneath and laterally by elongate bars, the latter much longer than J-shaped ones; elongate bars and a single median bar slightly protruding into prephallotremic area, the median bar not visible in lateral view. Length .836-.988 mm., width at base .336-.411 mm., aedeagal struts .312-.399 mm.

*Neotype locality:* Topeka, Kansas. Say's type locality: "United States."

*Neotype:* Male, coll. Popenoe (WPH).

*Neallotype:* Female, Oakwood, Illinois, June 14, 1931, Frison (ISNHS).

*Neoparatypes*: CANADA: Toronto, Ontario, R. J. Crew, ♀, (USNM); Prince Edward Co., Ont., September 15, 1918, J. F. Brimley, ♂, (USNM); DISTRICT OF COLUMBIA: 1 ♂, 3 ♀ (USNM), ♂, ♀, (HFS); FLORIDA: LaBelle, July 16, 1939, Oman, ♂, (USNM); GEORGIA: Fort Valley, June 21, on peach, E. R. Selkregg, Quaintance No. 19661, ♂, (USNM); Barnesville, June 30, 1910, on peach, Quaintance 5709, ♀, (USNM); ILLINOIS: Centerville, Sangamon River, August 16, 1914, ♂, (ISNHS); Carbondale, June 10, 1904, jarred from apple, Ac. No. 34745, Taylor, ♀, (ISNHS); Northern Illinois, June 2, Peabody Coll., 2 ♀, (ISNHS); E. St. Louis, Rose Lake, July 19, 1906, ♀, (HFS); Willow Springs, June 14, 1912, ♀, ♂, (HFS); IOWA: Henry Co., May 21, 1936, Knutson, ♂, (IISC); Lake Okoboji, June 24, 1916, L. L. Buchanan, ♂, (USNM); Iowa City, Wickham, ♂, (USNM); KANSAS: Topeka, Popenoe, ♀, ♂, (USNM), ♀, (HFS); Riley Co., Popenoe, ♀, (USNM), ♀, (WPH); Onaga, Wickham, ♂, (HFS); LOUISIANA: New Orleans, August 2, 1904, U. S. D. A. 8583, Graybill, ♂, (USNM), ♂, (HFS); MARYLAND: College Park, July 20, 1921, bred from *Aquilegia*, H. S. McConnell, ♂, (USNM), ♂, (HFS); Beltsville, July 10, 1919, L. L. Buchanan, ♀, (WPH); MASSACHUSETTS: Melrose High, May 30, 1908, D. H. Clemons, ♀, (USNM); MISSISSIPPI: Natchez, June 3 and 7, 1909, at light, E. S. Tucker, ♂, ♀, (USNM); Meridian, H. Soltau, ♀, (USNM); MISSOURI: St. Louis, June 24, 1938, U. S. D. A. Traps, ♂, (HFS); Kansas City, 25.5, H. Soltau, ♀, (USNM); Missouri, C. V. Riley, ♀, (HFS); Caleb, May 24, 1885, J. S. Barlow, ♀, ♂, (USNM); MONTANA: 2 ♀, (HFS); NEW JERSEY: Coll. F. H. Chittenden, ♂, (USNM); NEW YORK: New York City and vicinity, ♂, (USNM); OHIO: Chagrin Falls, May 20, 1935, Host, Columbine, larvae in stems, C. R. Neiswander, ♀, (USNM); OKLAHOMA: Vinita, Indian Territory, June 7 and 8, 1899, Wickham, ♂, (USNM); TEXAS: Columbus, Hubbard and Schwarz, ♂, (USNM); Texas, ♀, (USNM), ♀, (HFS); Victoria, October, 1913, found in cotton squares sent from Tallulah, La., B. R. Coad, ♂, (USNM); VIRGINIA: Black Pond, June 28, 1935, Wash., D. C., H. S. Barber, ♀, (USNM); Fredricksburg, May 2, 1900, W. D. Richardson, ♂, ♀, (USNM); Great Falls, August 24, 1919, L. L. Buchanan, ♂, (USNM); Nelson County, June 26, 1914, W. Robinson, ♀, (USNM); WEST VIRGINIA: West Sulphur, July 18, 1914, W. Robinson, ♀, (USNM); Kanawha Sta. July 6, 1905, Hopkins 6036b, Mulberry, ♀, (HFS).

*Distribution*: "Ranges from New England to Michigan and Iowa, south to Florida and Texas," Blatchley and Leng (1916). Range extended west to Montana. Records from states other than those previously listed: Kentucky, Maine, Michigan, North Carolina, and Wisconsin.



*Biology:* *C. anaglypticus* (Say) has recently been considered as an economic pest of peach in the south (Peairs, 1941, and Snapp, 1930). The curculio, however, has a wide range of hosts of which peach is by no means the most preferred.

Brooks (1924) states that the larva of this species attacks peaches, cotton bolls, and the cambium and inner bark of various fruit and shade trees. The latter method of attack has given the insect the name "cambium curculio." Trees become infested at breaks or wounds in the bark, 20 to 38 larvae sometimes feeding at the edge of a single wound. Infested wounds are enlarged, and their healing is retarded or prevented by the feeding of the larvae. Brooks found larvae feeding at bark wounds on apple, pear, pignut (*H. glabra*), American hornbeam, sweet birch, American beech, American chestnut, white oak, chestnut oak, red oak, tulip tree, service berry, red maple, tupelo, flowering dogwood, and sourwood. Very little host preference was shown by the curculio although apple and pear were especially attractive.

Snapp (1930) reports jarring *anaglypticus* (Say) and *nenuphar* (Hbst.) from peach trees, the latter being greatly predominant. This worker definitely proved that the cambium curculio injures sound peaches, the previous conclusion having been that peaches, to be infested, must be bruised or wounded. In Georgia there are two generations per year of *anaglypticus* (Say); its life-history is closely similar to that of *nenuphar* (Hbst.). Brooks (1924) records one generation per year in West Virginia.

Specimen as well as literature records show that this species also breeds in cotton bolls in Louisiana. According to T. H. Jones (Brooks, 1924), the larvae feeding in the bolls seem to prefer to work around the stem ends. Jones found the larvae fairly common in bolls, but was unable to decide whether they caused the primary injury or follow other injury. Folsom (1936a) reports that at Tallulah the adults feed on the squares in July and August, making them turn yellow and fall.

A new host plant for *anaglypticus* (Say) is columbine (*Aquilegia*). Both H. S. McConnell, College Park, Maryland, and C. R. Neiswander, Chagrin Falls, Ohio, have bred specimens from this plant. The larvae of the Ohio specimens were in the stems of the plant.

Other specimen records reveal possible additional hosts: "feeding on cowpea" (Baton Rouge, La., C. E. Smith); "on *Crataegus* and plum" (Opelousas, La., R. A. Cushman); "on Japanese plum, flower buds" (Belle Chasse, La.); "on diseased elm" (Morristown, N. J., H. Hoffman); and "mulberry" (Kanawha Sta., W. Va., A. D. Hopkins).

Records from Indiana, Maryland, North Carolina, District of Columbia, Texas, and Delaware reveal that *anaglypticus* (Say) is attracted to light.

Brooks (1924) indicated that two parasites, *Thersilochus conotracheli* Riley (Hymenoptera) and *Myiophasia globosa* Townsend (Diptera), probably attack the larvae of the cambium curculio.

*Remarks:* *C. anaglypticus* (Say) is common in the midwestern area, being present in all the collections studied. The two yellowish oblique bars on the elytra make this species one of the easiest to recognize of all species of *Conotrachelus*. It is most closely related to *leucophaeatus* Fahr.

*Conotrachelus leucophaeatus* Fahreus

*Conotrachelus leucophaeatus* Fahreus, 1837, Schönh. Gen. Spec. Curc., IV, pt. 1, p. 417; Leconte and Horn, 1876, Rhynchophora N. A., Proc. Amer. Philos. Soc., XV, No. 96, p. 234; Champion, 1904, Biol. Cent. Amer., IV, pt. 4, p. 394; Blatchley and Leng, 1916, Rhynchophora N. E. Amer., p. 481; Mutchler and Weiss, 1925, Conotr. N. J., Circ. 87, Bur. Stat. and Insp., Dept. Agr., N. J., p. 19. *Conotrachelus demens* Boheman, 1837, Schönh. Gen. Spec. Curc., VIII, pt. 2, p. 31.

*Length:* 3.8-5.4 mm.

*Special characters:* Eyes contiguous beneath or nearly so; interocular distance not greater than twice the diameter of a facet; prothoracic furrow broad, bordered on each side by a distinct ridge; disc with a longitudinal, median carina, deeply and roughly punctate; white elytral band bordered basally and apically by brownish areas.

*Color:* Elytra reddish-brown mixed with black; apical declivity light reddish-brown; prothorax dark reddish to piceous.

*Head:* Punctures dense, coarser apically; rugulose; practically bare; groove above eye sometimes densely set with tannish setae; a few broader white setae usually present at middle; beak feebly curved; curvature abrupt near antennal insertion; subequal in length to prothorax and in both sexes; trisulcate laterally between base and antennal insertion; sulci in male usually distinct; in female the upper and median sulci frequently feeble or evanescent; sulci punctate; dorsal surface in male with an acute carina from base to distad of middle; carina either present or absent in female; dorsal tip distad of antennal insertion with elongate punctures, dense and coarse or sparse and fine; surface densely rugulose, especially evident when sulci are obscure; sulci sparsely set with chiefly pale tan or brown setae; several broader, more evident, reddish-yellow or white setae in the lower sulcus basally and at the dorsal point of junction of beak and eye; antennae inserted one-fourth to one-third before apex.

*Prothorax:* Slightly wider than long; sides subparallel to near apex, then constricted; ridges bordering median furrow sometimes tuberculate at their posterior points; densely punctate with large, deep pits; the prominent median longitudinal carina extending from before base anteri-

only into furrow, ending subapically, usually stoutest basally, tending to be finer and evanescent apically, either straight or tortuous; densely rugulose; sparsely clothed with reddish-yellow, tan, brown, and white recumbent to suberect setae varying in length, sometimes recurved; the shorter white (sometimes mixed with tannish) setae on each side forming a sinuate line from basal angle diagonally to postocular lobe; white setae also forming a variable prominent pattern above this line; usually two branches of this pattern unite with diagonal line, one apically, the other at basal angle so that an irregular triangle is formed; usually one basal and two apical branches complete this pattern; the longer reddish-yellow and pale white setae sparsely but usually conspicuously interspersed in pattern.

*Elytra*: Nearly three-fourths as wide at the base as long; sides subparallel for more than half, then gradually converging to apex; sometimes convergence abrupt; basal border feebly emarginate before the humeri; the latter not prominent, rounded; interval 3 moderately costate, with costa most evident posteriorly, sometimes interrupted anteriorly or both anteriorly and posteriorly; elevations feeble; interval 5 with a feeble to moderate costa, interrupted subbasally; intervals 7 and 9 feebly costate; serial punctures coarse; moderately dense to dense vestiture, chiefly of recumbent white and pale white setae which cover elytra in a broad band from behind humeri to apical declivity; setae densest in an oblique stripe through subbasal interruption of costa of interval 5; setae usually less dense elsewhere, particularly in discal area between third intervals; elytral area anterior to white band with sparse covering of mainly reddish-yellow and reddish-brown setae which are condensed on humeri and on intervals 3 and 5, especially 3; brownish setae usually forming a dark spot on interval 3 behind the middle and frequently on interval 2; apical declivity sparsely covered with mostly reddish-yellow and reddish-brown setae; intervals frequently set with tan and white subrecumbent setae, usually more evident on alternate intervals; vestiture frequently obscuring serial punctures and costae.

*Ventral surface*: Anterior border of mesosternum triangulate or straight, varying in prominence; metasternum with a ridge from meso- to metacoxa. Abdominal sterna 1, 2, and 5 densely and coarsely punctate; sterna 3 and 4 with punctures sparser and usually larger than those of sterna 1, 2, and 5; coarseness of punctures varying in different specimens; sternum 5 without tubercles or depressions; abdominal surface densely rugulose; each puncture with a fine amber or brownish seta; lateral setae on sterna 2, 3, and 4 broader and white, tan, or reddish-yellow, forming conspicuous patches; also a patch of broader setae on apical border of sternum 1 on each side of middle.



*Legs:* Femora with a tooth and denticle; metaunci in both sexes nondentate; apical half of femora with moderately dense to dense vestiture of white, yellow, and brown setae; metafemora more conspicuously banded than others, color usually white.

*Male genitalia:* (Figs. 68 and 95). Aedeagus elongate, approximately three times as long as wide at base, and approximately three times the length of the aedeagal struts; sides bisinuate and abruptly curving at apex to form an elongate process; outer curvature sometimes less abrupt and apical process wider than in Fig. 68; dorsal membrane elongate, with apical border V-shaped; transfer apparatus distinctly projecting into prephallotremic area; laterally both dorsal and ventral curvatures depressed medially. Length 1.125-1.312 mm., width at base .351-.375 mm., aedeagal struts .312-.375 mm.

*Type locality:* Mexico.

*Type:* Fahreus Collection, Stockholm Museum, Stockholm, Sweden.

*Distribution:* Ranges from Wisconsin and Indiana to Colorado, south to Alabama, Texas, Arizona, and Mexico. Mutchler and Weiss (1925) mention two records from New Jersey, and Brimley (1938) one from North Carolina. The specimen upon which the Brimley's record was based has on examination proven to be *obesulus* Hust., and the New Jersey records are questionable in view of the species' rather limited southern and western distribution. Records from Arizona, Colorado, Kansas, Oklahoma, Texas, and Wisconsin.

*Biology:* Specimen labels show that *leucophaeatus* Fahr. has been taken frequently on *Euphorbia marginata* in Texas and Kansas. Pierce (1907a) reports that it breeds in the stems of this weed, the larvae being present throughout the summer. Blatchley and Leng (1916), in quoting Pierce, erroneously give the species as *E. corollata*.

A second definite host is *Argemone*, prickly poppy, specimens of *leucophaeatus* Fahr. having been bred from this plant by S. G. Kelly at Manhattan, Kansas. It has also been collected on *Argemone mexicana* by R. A. Cushman at Hallettsville, Texas.

Other specimen records reveal that *leucophaeatus* Fahr. frequents cotton and milkweed: "*Asclepias* sp." (Childress, Texas, J. D. Mitchell); "on milkweed" (Victoria, Texas, B. R. Coad); "collected on cotton" (Chillicothe, Texas, E. S. Tucker); "on cotton, apparently feeding on cotton squares" (Victoria, Texas, W. D. Hunter); and "on cotton squares" (10 mi. N. E. Uvalde, Texas, O. C. Parman). Pierce (1907a) reports it being taken on cotton at Victoria, Denton, Runge, and San Antonio, Texas, on corn at Dallas, and on *Quercus* at Gurley. Sanderson (1904) states that *leucophaeatus* Fahr. breeds in stems of *Amaranthus*, but this record has not since been substantiated.

This species has also been collected "at lights" in Kerrville, Texas, and Durant, Oklahoma.

*Remarks:* *C. leucophaeatus* Fahr. is typically a southwestern species, rarely being found in the eastern half of the United States. Champion (1904) states that it is quite common in Mexico, and Blatchley and Leng (1916) report it abundant in Texas.

This species is closely allied to *obesulus* Hust., of which only a few specimens have been collected. *C. obesulus* Hust. was originally described by Fall as *obesus* in 1917, but Hustache in 1936 pointed out its preoccupation by *obesus* Pascoe 1881 and erected the new name. Fall, in his original description, stated that *obesulus* Hust. and *anaglypticus* (Say) have a close affinity, and that the two are differentiated mostly by *anaglypticus* (Say) having its costae non-interrupted in comparison to *obesulus* Hust. which has the costae of intervals 3 and 5 interrupted anteriorly. The costa of interval 5 in *anaglypticus* (Say), however, is always distinctly interrupted anteriorly; so whether Fall really had *anaglypticus* (Say) in mind when he wrote this statement is somewhat questionable. The type of *obesulus* Hust., seen in Fall's Collection at the Museum of Comparative Zoology, resembles *leucophaeatus* Fahr. very much except that it is extremely broad and robust in comparison to that species. Unfortunately, most of its vestiture is rubbed off so that it looks unnaturally bare. A male specimen of *obesulus* Hust. from Southern Pines, North Carolina, has the aedeagus with the lateral plates gradually converging apically to form the apical process in contrast to the abrupt convergence in *leucophaeatus* Fahr. (Fig. 68). The prothoracic ridges in this specimen are less evident than those in *leucophaeatus* Fahr., and the eyes are less contiguous. With only one specimen of *obesulus* Hust. at hand, however, the writer hesitates to enumerate differences between the two species. More specimens of *obesulus* Hust. are necessary for examination before definite characters for the differentiation of the two species can be set up. For the present the more robust form and less contiguous eyes of *obesulus* Hust., plus the previously mentioned aedeagal difference, will serve for the separation of the two species.

#### GROUP IV

This group includes Divisions III and IV of Leconte and Horn (1876) and Groups V and VI of Blatchley and Leng (1916). It comprises those species of *Conotrachelus* which have the tarsal claws approximate and deeply cleft. In the North Central States two species of Group IV are present, *erinaceus* Lec. and *fissunguis* Lec. The previously quoted writers, however, put each of these species in a different group, although both are closely linked by their tarsal affinities. The principal differ-

ence stated by Blatchley and Leng between the two species, and thus between the two groups, is that Group V has a prostrate fine pubescence mixed with short bristles, whereas Group VI has the pubescence mixed with fine, stout bristles.\* Other subordinate differences listed are: Group V has the beak as long as the head and thorax, carinate and coarsely striate on the basal two-thirds; antennae inserted one-fifth from its tip; elytra with rows of very short bristles; and tarsal claws cleft at the tip. Group VI has the beak rather slender, longer than the head and thorax, feebly striate, finely and sparsely punctate; elytra with long, stout, erect bristles; and tarsal claws deeply cleft. Of these contrasting characters, the differences in the type of bristles and the length of the beak appear to be the most reliable ones. The other characteristics are either equally applicable to both groups, or as in the case of the difference in the punctuation of the beak, not of group significance. Just what is meant by Blatchley and Leng's statement that the tarsal claws in *fissunguis* Lec. are cleft at the tip is not clear, since the claws of both species are equally cleft.

The question then arises whether the two characters mentioned, the "bristles" and the beak, are of group significance. In the writer's opinion they are not. The beak varies greatly in relative length, as in Group I where in the female of *affinis* Boh. it attains the abdomen, in *nenuphar* (Hbst.) and *albicinctus* Lec. it barely reaches the mesosternum, and in *seniculus* Lec. and *nivosus* Lec. it is subequal to the prothorax in length. "Bristles" likewise vary within the other groups, as in Group II where *cribricollis* (Say) has stout, erect "bristles" similar to those of *erinaceus* Lec. while *geminatus* Lec. has much finer and shorter ones. Consequently, it would appear that if the above differences are used in one place to set up groups, such differences should not be ignored in other places. Because of these facts, Groups V and VI of Blatchley and Leng have, therefore, been consolidated into one. It may be pointed out that since these groups were originally erected for convenience of treatment, it might be well to retain the division. This does not apply since the treatment of the two species in question is just as convenient when included under one group as when under two. In addition, a one-group classification shows that there is a closer relationship between these two species than there is between either of these species and any species of the other groups.

Group IV is characterized chiefly by its approximate, cleft tarsal claws. Other characteristics are: beak feebly curved; first two funicular segments of antennae subequal in length and longer than any of the others; prothorax wider than long, coarsely and densely punctate, punc-

\*The term, "bristles," is synonymous with the term suberect or erect setae used in the descriptions of the species in question. It is used above, however, to facilitate discussion. The setae, in the writer's opinion, are too broad to be called "bristles."



tures with suberect to erect setae; elytral intervals not costate and with suberect setae; mesoscutellum from lateral aspect abruptly declivent basally; metasternum not grooved from meso- to metacoxa in either sex; femora with a single tooth; aedeagus elongate, depressed apically, with a dorsal membrane and an apical process; transfer apparatus with two or more pairs of sclerotized bars.

## KEY TO SPECIES OF GROUP IV

1. Elytra with suberect setae of intervals only slightly longer than recumbent setae; prothorax bare except for short suberect setae arising singly from punctures; aedeagus as in Fig. 65.....*fissunguis* Lec., p. 131
- 1- Elytra with suberect setae of intervals from two to three times as long as recumbent setae or scales; prothorax with numerous scattered scale-like setae or scales in addition to the long suberect setae arising from the punctures; aedeagus as in Fig. 64.....*erinaceus* Lec., p. 134

*Conotrachelus fissunguis* Leconte

*Conotrachelus fissunguis* Leconte, 1876, Rhynchophora N. A., Proc. Amer. Philos. Soc., XV, No. 96, p. 234; Blatchley and Leng, 1916, Rhynchophora N. E. Amer., p. 481; Mutchler and Weiss, 1925, Conotr. N. J., Circ. 87, Bur. Stat. and Insp., Dept. Agr., N. J., p. 19.

*Length:* 4.2-5.4 mm.

*Special characters:* Elytra with a median, discal, subglabrous, blackish area; profemur with a distinct anterior bulge opposite femoral tooth; similar bulge absent on meso- and metafemora; abdominal sterna 3 and 4 with punctures dense and present over the entire area.

*Color:* Elytra reddish-brown with areas of black at middle on disc and along sides, and on anterior face of humeri; prothorax piceous, darker than elytra.

*Head:* Densely punctate; punctures with tan and pale setae, sometimes scarcely visible unless highly magnified; beak stout, feebly curved; curvature more abrupt near antennal insertion; beak as long as prothorax, subequal in length in both sexes, trisulcate laterally between base and antennal insertion; lower and median sulci distinct; the upper one feeble and obscure, sometimes replaced by dense punctures; dorsal surface occasionally feebly carinate proximad of antennal insertion; tip distad of antennal insertion with dense elongate punctures, frequently coalescing and forming small sulci; sparse pale tan setae in lateral sulci; antennae inserted approximately one-fourth from apex.

*Prothorax:* Sides feebly rounded from base to apex or subparallel with a feeble subapical constriction; disc densely and coarsely punctate; punctures deep, frequently confluent and forming longitudinal ridges, the most prominent and constant of which is a median one; this ridge some-

times absent, its length variable; virtually bare except for short, inconspicuous, suberect or erect, pale tan or brown setae in punctures, one to each puncture.

*Elytra*: More than three-fourths as wide as long; sides subparallel for more than half, then gradually converging to apex; sometimes entire outline rounded from base to apex, the curvature feeble basally; basal border emarginate before humeri, the latter not prominent and rounded; intervals flat; sometimes intervals 3, 5, 7, and 9 very feebly convex; serial punctures coarse; with a moderate to dense covering of pale tan, or white and tan, recumbent setae except in blackish areas; setae in these areas sparse, the areas bare in appearance, specimens usually rubbed and frequently with elytra subglabrous in numerous areas; setae darker subapically; intervals each set with a row of white and tan, short, suberect setae, more evident posteriorly, frequently difficult to see.

*Ventral surface*: Mesosternum feebly angulate anteriorly. Abdominal sterna with dense coarse punctures, small considering size of species; sternum 1 occasionally less densely punctate than others; sternum 5 without tubercles and usually without depressions (one specimen with a median transverse depression); punctures usually with short, fine, obscure, amber setae, occasionally replaced by broader, white, or tan, easily observed setae, the latter when present usually on sterna 1 and 2 and along sides of 3 and 4.

*Legs*: Femoral tooth usually feeble; metaunci not dentate in either sex; female usually but not always with a tooth on outer apical edge of metatibia opposite the uncus; legs sparsely covered with tan and reddish-yellow setae, densest apically on femora.

*Male genitalia*: (Figs. 65 and 92). Aedeagus twice as long as wide at base, and three times as long as aedeagal struts; sides feebly sinuate and gradually converging at apical third to form a process; inner curvature evanescent basally, varying in distinctness in individual specimens; dorsal membrane narrowed to near base, then expanded; apical border V-shaped; transfer apparatus with a pair of sinuate bars bordering a median pair of feebly curved ones, the latter approaching apically to form a broad V; laterally, ventral curvature sometimes not as abrupt as in Fig. 92. Length 1.14-1.18 mm., width at base .461-.500 mm., aedeagal struts .351-.375 mm.

*Type locality*: Southern States (Louisiana, according to Leconte, 1876).

*Lectotype*, hereby designated: Museum of Comparative Zoology Type No. 5220-2, J. L. Leconte Collection (MCZ).

*Lectoparatypes*: Museum of Comparative Zoology Type No. 5220-3, Southern States; J. L. Leconte Collection (MCZ). Museum of Com-

parative Zoology Type No. 5220-1, no locality, but probably same as above since species was described from three Louisiana specimens; J. L. Leconte Collection (MCZ).

*Distribution:* "Ranges from New Jersey and District of Columbia to Louisiana," Blatchley and Leng (1916). Range extended west to Missouri, Illinois, and Texas. Records from: District of Columbia, Illinois, Louisiana, Maryland, Missouri, New Jersey, Pennsylvania, Texas and Virginia.

*Biology:* Pierce (1907a) and Blatchley and Leng (1916) record *fissunguis* Lec. as breeding in the swamp rose mallow, *Hibiscus moscheutos* L. Weiss and Dickerson (1919) from studies on the biology of this species on *H. moscheutos* report that the curculio's attacks appear to be confined to the seed capsules of *Hibiscus*. Since then this species has become known as the hibiscus seed capsule curculio.

In New Jersey, according to Weiss and Dickerson (1919), the curculio passes the winter in the adult stage, appearing the following year in July. These adults feed at the base of the flower petals, the females beginning oviposition as soon as the seed capsules are formed. The eggs are deposited in the seed capsules, being inserted through irregular circular punctures in the wall. Some capsules are punctured as many as eighteen times, others only two or three times. The newly hatched larva bores into the developing seed and feeds upon it until only the outer shell remains. When too large to enter the seeds, the larva consumes them from the outside. On attaining full growth, the larva leaves the capsule by cutting a circular hole through the wall or by merely crawling out if the capsule has split open. After dropping to the ground, it burrows one-half to one inch below the surface of the soil for pupation. From laboratory data, Weiss and Dickerson (1919) found that the larvae entered the soil on August 27, pupated on September 2, and transformed to the adult stage on September 18. For several days the adults remained in the soil, issuing on and after September 22. These adults then went into hibernation until the following summer. Weiss and Dickerson (1919) found infested seed capsules only on plants bordering a marsh. This was explained on the basis that marsh ground itself, being almost constantly wet, would hinder successful pupation.

Specimen records reveal that other species of mallow are also attacked: "bred from *H. lasiocarpus*" (Baton Rouge, La., T. H. Jones); "in seed of *H. militaris*" (District of Columbia; and "bred *H. militaris* pod" (Mitchener, La.). In Louisiana, specimens were bred as early as July 30, and this suggests that the life history in the southern states may be slightly different from that in New Jersey.

L. Haseman also found this species on wild cotton at Malden, Mis-



souri. It has been collected "at lights" at Wharton, Texas, and Washington, D. C.

*Remarks:* *C. fissunguis* Lec. is fairly common in Illinois.

*Conotrachelus erinaceus* Leconte

*Conotrachelus erinaceus* Leconte, 1876, Rhynchophora N. A., Proc. Amer. Philos. Soc., XV, No. 96, p. 235; Blatchley and Leng, 1916, Rhynchophora N. E. Amer., p. 482.

*Length:* 2.85-3.35 mm.

*Special characters:* Apical half of head densely covered with scales or scale-like setae; elytral vestiture dense, composed chiefly of recumbent scales; abdominal sterna 3 and 4 each with a row of coarse, closely set punctures.

*Color:* Elytra reddish-brown, with several splotches of black; prothorax dark reddish-brown to piceous.

*Head:* Densely punctate and thickly covered with reddish-yellow, tan, and white scale-like setae or scales on the apical half; basal half with scale-like or oblong setae, much sparser than on apical half; beak feebly curved, longer than prothorax, slightly longer in female than in male, slightly stouter in male; trisulcate laterally between base and antennal insertion; upper sulcus feeble, especially in the female where it is replaced subapically by fine punctures; dorsal surface sometimes with a feeble rounded ridge, distad of antennal insertion with fine, sparse to moderately dense punctures, usually sparse in female; sulci with a few tan and white, elongate setae; setae more scale-like and denser dorsally between the eyes; antennae inserted one-third to one-fourth from apex, in male nearer one-fourth.

*Prothorax:* Sides subparallel or feebly rounded, constricted subapically; disc with large, deep, and dense punctures, the latter sometimes confluent; non-carinate; white and tan recumbent scale-like setae or scales scattered over disc, sometimes condensed longitudinally at middle and along sides; each puncture with a suberect or erect white, tan, or dark brownish seta.

*Elytra:* Approximately one-fourth longer than wide; sides parallel for more than half, then gradually converging to apex; basal border feebly emarginate before humeri; the latter not prominent, rounded; intervals not costate, at the most feebly convex; serial punctures coarse, mainly hidden by vestiture; the latter a dense mixed covering of white and tan scale-like recumbent setae or scales, tan scales usually predominant; each interval with prominent, elongate, suberect setae ranging from white and tan to dark brown, or black; setae sometimes absent basally, especially on intervals 2, 4, and 6.

*Ventral surface:* Mesosternum triangulate anteriorly. Abdominal sterna with coarse punctures; sterna 1 and 5 moderately to densely punctate; sternum 2 usually more sparsely punctate, sometimes with a smooth transverse median area; sterna 3 and 4 with a transverse row of closely-set punctures; sternum 5 without tubercles or depressions; each puncture with an elongate, recumbent to suberect, tan or white seta; lateral, recumbent, white setae on sterna 3 and 4 forming small patches.

*Legs:* Femora with a small tooth; metaunci dentate in male only; metatibiae in both sexes with a denticle on outer margin of apex, opposite the uncus; legs with a sparse covering of white and tan, recumbent and suberect setae, some scale-like, others elongate; vestiture denser on apical half or third of femora.

*Male genitalia:* (Figs. 64 and 91). Aedeagus two and one-half to three times as long as wide at base, and approximately five times the length of the aedeagal struts; sides sinuate; abruptly curved one-third before apex to form an elongate process; dorsal membrane narrowed basally; membrane variable in its basal extension; apical border broadly V-shaped; transfer apparatus consisting of three pairs of bars; the basal and most evident pair with apical tips approaching medially to form a broad U. Length .851 mm., width at base .274-.298 mm., aedeagal struts .149-.161 mm.

*Type locality:* "Southern States."

*Lectotype*, hereby designated: Museum of Comparative Zoology Type No. 5219-2, J. L. Leconte Collection (MCZ).

*Lectoparatypes:* Museum of Comparative Zoology Type No. 5219-3, Texas, J. L. Leconte Collection (MCZ); Museum of Comparative Zoology Type No. 5219-1, no locality, J. L. Leconte Collection (MCZ).

*Distribution:* "Ranges from Ohio and Northern Indiana to District of Columbia, Florida and Texas," Blatchley and Leng (1916). Extension of range north to New York, and west to Missouri and Kansas. This species is recorded by Blatchley and Leng (1916) as frequent in southern Indiana but scarce in the northern area of that state. From this literature record and specimen records, it appears that *erinaceus* Lec. cannot survive in large numbers in the more northern sections of the United States. Only one record (Turin, N. Y.) shows this species occurring farther north than 42.5° latitude. Records from: Alabama, Arkansas, District of Columbia, Florida, Georgia, Illinois, Kansas, Kentucky, Louisiana, Missouri, New York, Ohio, Oklahoma, Tennessee, Texas, Virginia.

*Biology:* Literature and specimen data reveal this species as a pest of cotton. Folsom (1936a and b) reports this curculio common in cotton

fields at Tallulah, Louisiana, from late May to September. He states that the curculios usually occur in the bud clusters of the cotton plant, where they eat into the buds and kill them. Many young squares are blasted while the older squares are caused to flare, turn yellow, and drop. The curculio also feeds on the stems and leaves, killing the latter by cutting into the petioles. In some instances small plants are also killed.

Folsom's data on *erinaceus* Lec. are substantiated by the available specimen records. The species has been recorded "on cotton" or "in cotton fields" at Dancy, Agricultural College, Kosciusko, Thornton, Clarksdale, Vicksburg, McCool, Port Gibson, Holly Bluff, and Natchez, Mississippi; at Blossom, Texas; at Henryette, Oklahoma; at Tallulah, Louisiana; and at Richland, Paragould, and Clarksville, Arkansas. More definite records are: "from cotton bud" (Wharton, Texas, R. L. McGarr); "injuring cotton buds" (Knoxville, Tenn., S. Marcovitch); and "kills tops of seedling cotton plants by punctures below cotyledon" (Knoxville, Tenn., D. M. Simpson). The last two records and the work reported by Folsom show definitely that cotton serves as a food source for *erinaceus* Lec. Whether the curculio actually breeds in the cotton, however, has not been revealed by these data.

Other miscellaneous specimen records are: "on Aster sp." (Wolfe City, Texas, F. C. Bishopp); "on Rubus" (Lafayette, La., R. A. Cushman); "Timothy seed" (Charleston, Mo., Satterthwaite); and "at light" (Tallulah, La., and District of Columbia). Pierce (1907a) reports taking *erinaceus* Lec. on *Baptisia* at Greenville, Texas.

*Remarks:* *C. erinaceus* Lec. is common in Illinois. It is easily recognized by its approximate cleft tarsal claws, and its prominent suberect elytral setae.

## VII. ADDENDUM

*Conotrachelus carolinensis* n. sp. does not occur in the area studied and therefore is included as an addendum. This species belongs to Group III by virtue of its dorsal prothoracic furrow. It can be readily separated from *tuberosus* Lec. by the costal character of couplet 1 in the key (p. 119). For further separation in Group III the key must be modified as follows:

2. Elytral vestiture usually not conspicuously white; if so, transverse whitish band is behind subbasal interruption of costa of interval 5, and each elytron has an oblique bar of yellowish vestiture behind humerus; male metatibia with apical emargination (Fig. 32a and b)..... 3
- 2- Elytral vestiture conspicuously white, a broad transverse white band extending from apical declivity to humerus; elytron never with an oblique yellow bar posterior to humerus; male metatibia not emarginate apically; aedeagus as shown in Figs. 68 and 95.... *leucophaeatus* Fahreus, p. 126



3. Each elytron with an oblique bar of yellowish vestiture extending postero-medially through subbasal interruption of costa of interval 5; bar usually distinct, sometimes faint, but always evident; prothoracic furrow usually feeble, rarely bordered by distinct carinae; apical emargination of male metatibia deep as shown in Fig. 32a; aedeagus as shown in Figs. 67 and 94; the J-shaped and elongate bars of transfer apparatus as shown in Fig. 107.....*anaglypticus* (Say), p. 121
- 3- Elytron never with an oblique bar of yellowish vestiture; oblique area across subbasal interruption of costa of interval 5 with short white recumbent setae, usually sparse; prothoracic furrow bordered on each side by distinct carinae; apical emargination of male metatibia shallower as shown in Fig. 32b; aedeagus as shown in Figs. 100 and 106; the J-shaped and elongate bars of transfer apparatus as shown in Fig. 104.....*carolinensis* n. sp., p. 137

*Conotrachelus carolinensis* n. sp.

*Length:* 2.55-3.80 mm.

*Special characters:* Eyes contiguous beneath or nearly so; interocular distance at the most 2-3 times the diameter of a facet; median furrow of prothorax distinct; lines of yellowish vestiture at base of elytral interval 3 conspicuous; the J-shaped and elongate bars of transfer apparatus as shown in Fig. 104.

*Color:* Elytra chiefly reddish-brown with splotches of black, prothorax reddish to black.

*Head:* Coarsely, densely, and roughly punctate; punctures larger apically; densely rugulose; setae in punctures usually inconspicuous except along midline and above eyes; beak stout, curved; curvature usually more abrupt just above the antennal insertion; beak shorter than or subequal to prothorax; trisulcate laterally between base and antennal insertion; upper and median sulci occasionally evanescent basally; sulci sometimes less distinct in female; dorsal surface acutely carinate from base to distad of middle; carina occasionally rounded in female; tip distad of carina in male with dense elongate punctures, in female punctures usually finer and sparse; sulci sparsely set with reddish-yellow, tan, and white setae, sometimes scale-like setae also present; antennae inserted approximately one-third before apex; first and second funicular segments subequal in length, first stouter than second, each longer than any of remaining segments.

*Prothorax:* Usually wider than long (one specimen with length equal to width); sides subparallel or gradually widening to before apex, then constricted; densely, coarsely, and roughly punctate; carinae bordering median furrow frequently tortuose, sometimes interrupted by punctures; posterior end of carinae sometimes tuberculate; disc sometimes with a median longitudinal carina; densely rugulose; a sparse vestiture

of reddish-yellow, pale brown, tan, pale white, and white, recumbent to suberect, elongate setae; the shorter white setae forming on each side a diagonal line from basal angle to postocular lobe; above this line white setae forming an irregular pattern, usually consisting of five short lines all converging laterally at approximately the middle; this arrangement frequently obscure in dirty rubbed specimens, otherwise conspicuous; the majority of the remaining setae arising singly from punctures.

*Mesoscutellum*: From lateral aspect abruptly declivent basally.

*Elytra*: Three-fourths to four-fifths as wide as long; sides subparallel for more than half, then gradually converging to apex; basal border feebly emarginate mesad of humerus; the latter rounded, feebly prominent; intervals 3, 5, 7, and 9 moderately to acutely costate; costa of interval 3 usually complete, sometimes feebly interrupted anteriorly or posteriorly or both; if twice interrupted, the elevations formed are feeble; costa of interval 5 interrupted once anteriorly; costae of intervals 7 and 9 complete, that of 7 sometimes evanescent near the humerus, that of 9 frequently less acute than costae of intervals 3, 5, and 7; serial punctures coarse, closely set; sparse vestiture of brown, tan, yellow, and white, short to elongate, recumbent setae; the white setae sometimes predominant; setae condensed basally in lines on intervals 3 and 5 and sometimes 4; base of each line composed of white setae succeeded posteriorly by reddish-yellow, yellow, or tan setae, a similar patch of vestiture across base of humerus; setae also denser at the beginning of the apical declivity; oblique area through subbasal interruption of costa of interval 5 usually very sparsely covered with short white setae; alternate intervals set, usually conspicuously, with brown, reddish-yellow, tan, and white, subrecumbent to suberect setae; those of interval 1 directed posteriorly; those of costate intervals directed toward costal crest; apical declivity usually with few setae, bare in appearance.

*Ventral surface*: Mesosternum triangulate anteriorly; metasternum not grooved but with a ridge from meso- to metacoxa. Abdominal sterna with coarse, deep punctures; those of 1 and 5 dense; those of 2, 3, and 4 varying from sparse to dense; punctation of 3 and 4 usually less dense than that of 2; the latter usually with finer punctures basally, a row of larger ones apically; punctures of sterna 3 and 4 usually large and frequently arranged in a transverse row; sterna densely rugulose; each puncture with a fine, pale brown or amber, elongate seta; lateral setae of sterna 3 and 4 broader, white or tan, forming patches; broader setae also on apical portion of sternum 1 each side of middle.

*Legs*: Femora with a tooth and a denticle; tooth usually prominent, sometimes feeble, especially on mesofemora; metafemora usually stouter than meso- and profemora; apical emargination of male metatibia fre-

quently gradual, not as abrupt as shown in Fig. 32b; metaunci in male dentate, those of female not dentate; metafemora moderately to densely clothed apically with whitish, sometimes tannish, elongate setae; meso- and profemora less densely clothed; setae of profemora usually more uniformly distributed.

*Male genitalia:* (Figs. 100 and 106). Aedeagus more than twice as long as wide at base and two to three times the length of the aedeagal struts; sides feebly sinuate and converging apically to form a process; the latter usually with sides subparallel, sometimes expanded near the apex; inner curvature with a distinct mesad extension basad of apical edge of dorsal membrane; the latter V-shaped apically; transfer apparatus with a pair of median J-shaped bars; beneath and obliquely across the outer curvature of each J-shaped bar lies an elongate bar (Fig. 104); the latter but slightly longer than the J-shaped bar, and not protruding into prephallotremic area; a median slightly sclerotized portion of apparatus prominently projecting into prephallotremic area; projecting portion visible in lateral view (Fig. 106). Length: .750-.850 mm., width at base .325-.390 mm., aedeagal struts .250-.325 mm.

*Type locality:* Garner, North Carolina.

*Holotype:* Male, United States National Museum Type No. 55134, summer, 1940, Coll. W. A. Majure, (USNM).

*Allotype:* Female, Garner, North Carolina, December 4, 1940, hibernating beneath lespedeza, grass, and composite weeds, W. A. Majure, (HFS).

*Paratypes:* ALABAMA: Pyziton, Clay Co., H. H. Smith, ♀, (USNM); ARIZONA: Globe, Duncan Coll., ♂, (USNM); FLORIDA: Dunnellon, July 12, 1939, Oman, ♀, (USNM); St. Nicholas, ♀, (USNM); Crescent City, Coll. Hubbard and Schwarz, ♂, (HFS); GEORGIA: Myrtle, May 30, 1906, jarred from peach, Quaintance No. 2361, A. H. Rosenfeld, ♀, (USNM); MARYLAND: Chesapeake Beach, June 9, 1933, mosquito trap, F. C. Bishopp, ♀, (USNM); MASSACHUSETTS: Springfield, June 28, 1903, F. Knab, ♀, (USNM); MISSISSIPPI: Agr. College, October 22, 1894, H. E. Weed, Coll. Wickham, ♂, (USNM); Meridian, Coll. H. Soltau, ♂, (HFS); New Albany, June, 1920, on peach, Quaintance No. 20707, L. Pierce, ♂, (USNM); NEW JERSEY: Woodbine, May 11, 1925, F. M. Schott, Coll. A. Nicolay, ♂, (USNM); NEW YORK: New York City and vicinity, ♀, (USNM); NORTH CAROLINA: Aberdeen, May 25, 1927, J. A. Harris, ♀, (HFS); TEXAS: Columbus, Hubbard and Schwarz, ♀, (USNM); Austin, Coll. H. Soltau, ♀, ♂, (HFS); Beeville, June 5, 1906, in cotton fields, C. R. Jones, ♂, (USNM); Texas, ♂, (USNM), ♀, (HFS); VIRGINIA: Fort Monroe, Hubbard and Schwarz, ♀, (USNM).



*Distribution:* Ranges in coastal strip from Massachusetts south to Florida, then west to Texas; also found in Arizona. Whether the distribution of this species is actually confined to eastern and southern border states is questionable, but present available records indicate such a range.

*Biology:* This species has been beaten from peach trees in Georgia and Mississippi and collected in cotton fields in Texas. These records indicate that its hosts are possibly similar in part to those of *anaglypticus* (Say).

*Remarks:* *C. carolinensis* n. sp. and *anaglypticus* (Say) are very closely related and heretofore have been considered as one species. The similarity of the male genitalia (Figs. 67 and 100) and the male metatibiae (Fig. 32a and b) reveal the extent of their affinity. The aedeagi of the two species are best differentiated by the relative lengths and position of the two sets of bars in the transfer apparatus (Figs. 104 and 107). The apical process of the aedeagus in *anaglypticus* (Say) is usually as shown in Fig. 67, but occasionally it varies toward the type exhibited by *carolinensis* n. sp. (Fig. 100), and the reverse is also true. The shape of the aedeagi of the two species is different, but this difference may not be as readily detected as that of the transfer apparatus.

In addition to the characters mentioned in the keys and diagnoses, two other relative differences are of interest. First, the length of *carolinensis* n. sp. generally averages less than that of *anaglypticus* (Say), even though overlapping occurs; and, second, the prothoracic punctation of *carolinensis* n. sp. is much coarser, frequently more like that of *leucophaeatus* Fahr. than that of *anaglypticus* (Say).

## VIII. SUMMARY

The morphological and taxonomical aspects of the genus *Conotrachelus* Dejean (Coleoptera, Curculionidae) have been studied in those species occurring in Illinois and the surrounding states of Wisconsin, Iowa, Missouri, Kentucky, and Indiana. The technique for the removal and preservation of the male genitalia is discussed in detail.

The taxonomic importance of the various morphological structures is evaluated. The uncus, mesoscutellum, and metasternal grooves are structures newly employed in the taxonomy of the genus. The characters for sex determination are given. The morphology of the male genitalia of *C. nenuphar* (Hbst.) is discussed fully and is followed by a discussion of the relative taxonomic value of the component parts of the genitalia.

Dejean (1835) is shown to be the author of the generic name, *Conotrachelus*, although in all previous works Schönherr (1837) or Latreille (1835) have been accredited with it.

Twenty-eight species occur in the area studied, five of which are new: *buchanani*, *iowensis*, *hicoriae*, *hayesi*, and *tibialis*. The species of the genus are segregated into four groups, instead of the usual six as proposed by Leconte and Horn (1876) and Blatchley and Leng (1916). The description of each species is followed, as far as possible, with a discussion of its distribution, biology, phylogeny, and nomenclature. Male genitalia, as well as the usual morphological characters, are utilized in the descriptions. Illustrations of the aedeagi and of other important taxonomic structures are included. In those cases where the types have definitely been destroyed, neotypes and neoparatypes have been erected.

The description of a new species, *carolinensis*, not found in the area studied, is presented as an addendum.

## IX. GLOSSARY

This glossary has been included so that the meaning of new or perhaps unfamiliar terms used in the section on classification can be readily obtained without recourse to the section on morphology.

Aedeagal strut—an elongate, ventral, basal extension of the aedeagus (Fig. 2).

Aedeagus—the distal, heavily sclerotized portion of the phallus (Figs. 1, 8, and 9).

Apical process—the apex of the aedeagus when it forms a projection (Figs. 42 and 54).

Declivent—modified by adverb “abruptly” and used in the description of the meso-scutellum, means that mesoscutellum is sharply cut off basally as shown in Fig. 30b or more so.

Densely punctate—with the punctures as shown in Fig. 33.

Distal femoral tooth—the tooth which is located either at the middle or on the proximal slope of the apical emargination of the femur; i.e., in Fig. 98 a distal tooth would be one located distad of the tooth (the proximal femoral tooth) shown at the proximal crest of the emargination.

Distance (a)—the distance between the lateral apical emargination of the beak and the anterior margin of the ball of the antennal scape (Fig. 105).

Distance (b)—the distance between the dorsal and ventral surfaces of the beak at the position of the antennal insertion (see Fig. 105).

Dorsal curvature—the upper boundary of the lateral plate when viewed from the lateral aspect (Fig. 69).

Dorsal membrane—the membranous, dorsal area between the two lateral plates of the aedeagus (Fig. 59).

Dorsal plate—the lightly sclerotized, dorsal area between the two lateral plates of the aedeagus (Fig. 1).

Elongate—at least two and one-half times as long as wide.

Endophallus—an eversible sac consisting of membranous lobes and sclerotized plates or bars which, in repose, is contained within the aedeagal cavity (Figs. 4 and 5).

Inner curvature—the inner boundary of the lateral plate when viewed from the dorsal aspect (Fig. 42).

Interrupted—with reference to the elytral costae: when the crest of the costa is definitely flattened so that an acute highlight is no longer visible.

Lateral plate—the heavily sclerotized plate which forms a side and part of the dorsal and ventral surfaces of the aedeagus (Figs. 1, 2, and 69).

Moderately punctate—with the punctures as shown in the top half of Fig. 34.

Metasternal groove—the groove extending from the mesocoxa to the metacoxa in the males of certain species (Fig. 19).

Mucro (pl. mucrones)—the spine arising from the inner apical angle of the tibia, frequently lacking in males and usually inconspicuous (Fig. 20).

Outer curvature—the outer border of the lateral plate when the aedeagus is viewed from the dorsal aspect (Fig. 42).

Prephallotremic area—the area distad of the phallotreme, thus distad of the apical border of the dorsal plate or membrane (Figs. 1, 42, and 54).

Phallobase—the proximal portion of the phallus, typically a sclerotized ring bearing two epimeres, usually encircling the aedeagus at its base (Fig. 1).

Phallotreme—the opening formed by the invagination of the endophallus beneath the apex of the dorsal plate or the dorsal membrane (Fig. 5).



Phallus—all of the structures of the external male genitalia including the phallobase, aedeagus, endophallus, connecting membranes, and any of the processes of these parts (Fig. 1).

Proximal femoral tooth—the tooth which is located at the proximal crest of the apical emargination of the femur (the tooth shown in Figs. 97 and 98).

Spinulae—small spines found in a row at the apical end of the tibia (Fig. 20).

Transfer apparatus—the sclerotized plates or bars of the endophallus (Figs. 7 and 59).

Uncus (pl. unci)—the spine arising from the outer apical angle of the tibia (Fig. 20).

Ventral curvature—the lower boundary of the lateral plate when viewed from the lateral aspect (Fig. 69).

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## PLATES

NOTE: In all of the genital illustrations excepting figures 4, 5, 7, and 11, the endophallus is not shown unless it projects into the prephallotremic area.

## PLATE I

Male Genitalia of *C. nenuphar* (Hbst.)

FIG. 1.—Dorsal view of phallus.

FIG. 2.—Ventral view of aedeagus.

FIG. 3.—Ventral view of phallus (slightly raised basally) within the body cavity.

FIG. 4.—Dorsal view of aedeagus, showing endophallus in repose.

FIG. 5.—Diagrammatic sketch of endophallus, showing the courses the various structures follow in the process of eversion.

FIG. 6.—Diagrammatic cross-section of ventral lobe of endophallus, showing lobe in repose (a) and everted (b).

FIG. 7.—Dorsal view of aedeagus, showing endophallus everted.

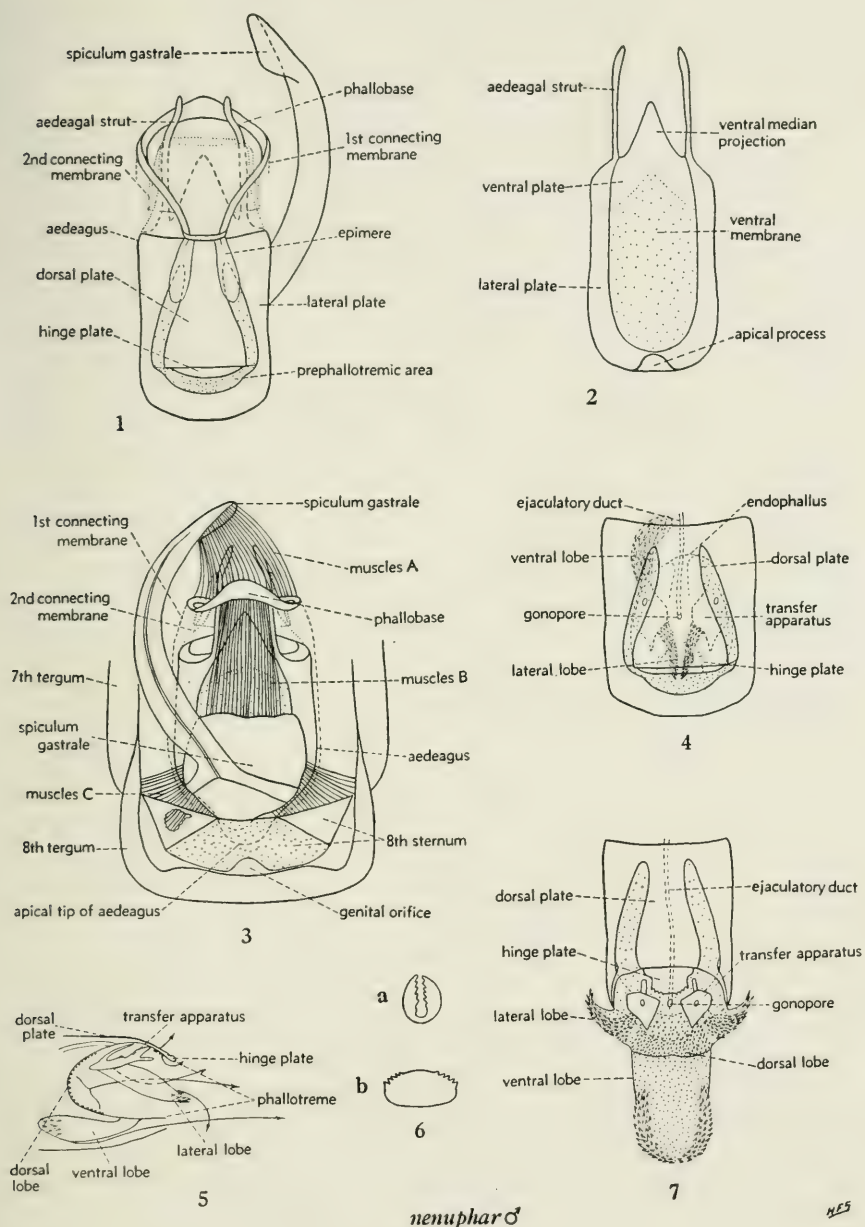
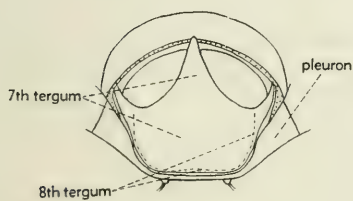
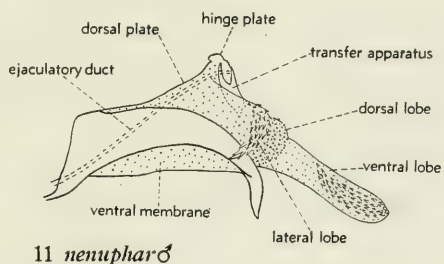
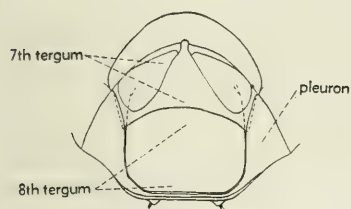
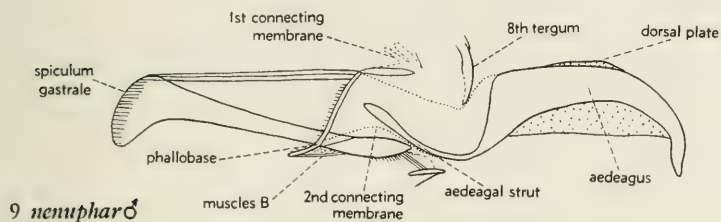
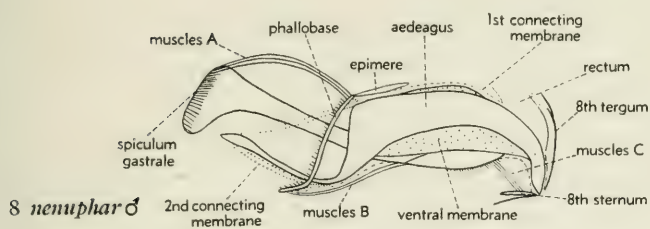


PLATE I



## PLATE II

- FIG. 8.—Lateral view of phallus within the body cavity, *nenuphar* (Hbst.).  
FIG. 9.—Lateral view of phallus, with aedeagus extruded from the body cavity, the endophallus in repose, *nenuphar* (Hbst.).  
FIG. 10.—Posterior view of male abdomen, showing visible eighth tergum, *nenuphar* (Hbst.).  
FIG. 11.—Lateral view of aedeagus, showing the endophallus everted, *nenuphar* (Hbst.).  
FIG. 12.—Posterior view of female abdomen, showing eighth tergum (dash line) concealed beneath seventh tergum, *nenuphar* (Hbst.).  
FIG. 13.—Ventral median section of phallobase, *juglandis* Lec., showing two types.  
FIG. 14.—Ventral median section of phallobase, *nivosus* Lec., showing two types.  
FIG. 15.—Ventral median section of phallobase, *elegans* (Say).  
FIG. 16.—Ventral median section of phallobase, *buchanani* n. sp., showing three types.  
FIG. 17.—Ventral median section of phallobase, *seniculus* Lec., showing three types.  
FIG. 18.—Ventral median section of phallobase, *aratus* (Germ.).



13 *juglandis*



14 *nivosus*



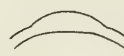
15 *elegans*



16 *buehanani*



17 *seniculus*



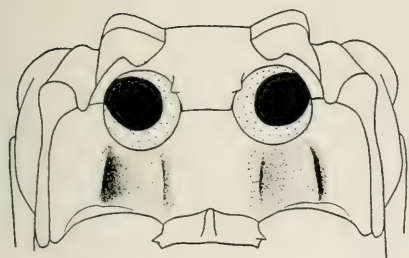
18 *aratus*

HE5

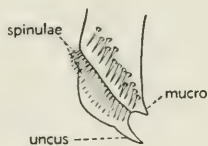
## PLATE III

- FIG. 19.—Ventral view of meso- and metathorax, *nenuphar* (Hbst.) ♂, showing the metasternal grooves from meso- to metacoxae.
- FIG. 20.—Anterior aspect of apex of mesotibia, *nenuphar* (Hbst.) ♀, showing uncus, mucro, and spinulae.
- FIG. 21.—Posterior view of male metauncus, *nenuphar* (Hbst.).
- FIG. 22.—Posterior view of male and female metaunci, *retentus* (Say).
- FIG. 23.—Posterior view of male metauncus, *hicoriae* n. sp.
- FIG. 24.—Posterior view of male and female metaunci, *affinis* Boh.
- FIG. 25.—Posterior view of male mesounci and metaunci, *elegans* (Say).
- FIG. 26.—Posterior view of male mesouncus and metaunci, *aratus* (Germ.).
- FIG. 27.—Posterior view of male metauncus, *tibialis* n. sp.
- FIG. 28.—Posterior view of male metauncus, *hayesi* n. sp.
- FIG. 29.—Mesoscutellum, *buchanani* n. sp., (a) dorsal aspect, (b) lateral aspect.
- FIG. 30.—Mesoscutellum, *albicinctus* Lec., (a) dorsal aspect, (b) lateral aspect.
- FIG. 31.—Anterior view of right protibia: (a) *tibialis* n. sp. ♂, (b) *aratus* (Germ.) ♂.
- FIG. 32.—Anteromedial view of left metatibia: (a) *anaglypticus* (Say) ♂, (b) *carolinensis* n. sp. ♂.





19 *nenuphar* ♂



20 *nenuphar* ♀



21 *nenuphar* ♂



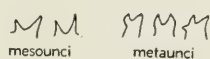
22 *retentus*



23 *hicoriae* ♂



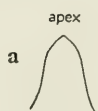
24 *affinis*



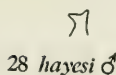
25 *elegans* ♂



26 *aratus* ♂



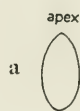
27 *tibialis* ♂



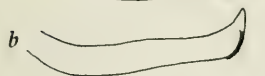
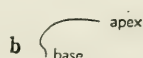
28 *hayesi* ♂



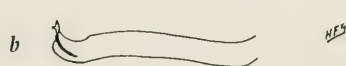
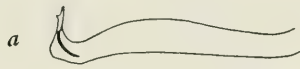
29 *buechanani*



30 *albicinctus*



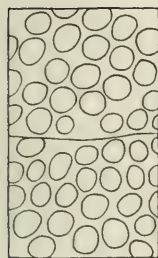
31 *a tibialis* ♂ *b aratus* ♂



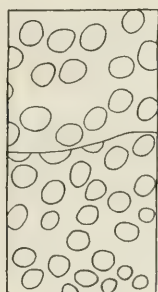
32 *a anaglypticus* ♂ *b carolinensis* ♂

## PLATE IV

- FIG. 33.—Punctures of first and second abdominal sterna, *elegans* (Say).  
FIG. 34.—Punctures of first and second abdominal sterna, *aratus* (Germ.).  
FIG. 35.—Lateral view of head and beak, *nenuphar* (Hbst.) ♀.  
FIG. 36.—Lateral view of head and basal portion of beak, (a) *affinis* Boh. ♀, and  
(b) *hicoriae* n. sp. ♀, showing relative distance between antennal scape  
and head capsule.  
FIG. 37.—Lateral view of head and beak, *hayesi* n. sp. ♂.  
FIG. 38.—Lateral view of head and beak, *aratus* (Germ.) ♂.  
FIG. 39.—Lateral view of head and beak, *elegans* (Say) ♀.  
FIG. 40.—Lateral view of head and beak, *hayesi* n. sp. ♀.  
FIG. 41.—Lateral view of head and beak, *aratus* (Germ.) ♀.



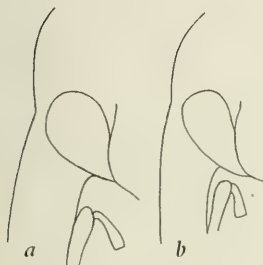
33 *elegans*



34 *aratus*



35 *nemophar* ♂



36 *a affinis* ♂ *b hickoriae* ♂



37 *hayesi* ♂



38 *aratus* ♂



45

39 *elegans* ♀



40 *hayesi* ♀



41 *aratus* ♀

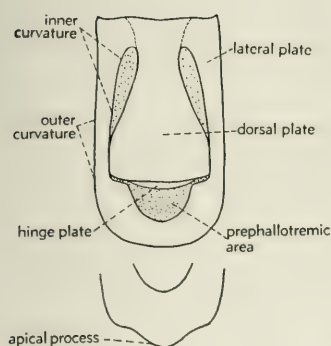


## PLATE V

Dorsal View of Aedeagus  
(including separate sketch of apex)

FIG. 42.—*juglandis* Lec.  
FIG. 43.—*nenuphar* (Hbst.)  
FIG. 44.—*buchanani* n. sp.  
FIG. 45.—*albicinctus* Lec.  
FIG. 46.—*iowensis* n. sp.  
FIG. 47.—*retentus* (Say)

FIG. 48.—*affinis* Boh.  
FIG. 49.—*hickoriae* n. sp.  
FIG. 50.—*falli* Blatch.  
FIG. 51.—*elegans* (Say)  
FIG. 52.—*hayesi* n. sp.  
FIG. 53.—*aratus* (Germ.)



43 *nemuphar*

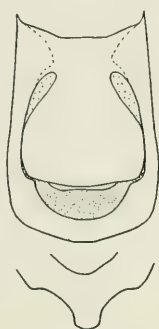
44 *buchanani*

45 *albicinctus*

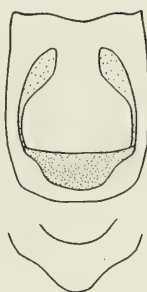
42 *juglandis*



46 *iowensis*



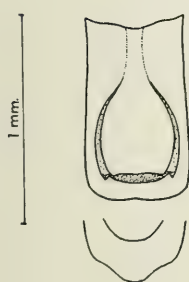
47 *retentus*



48 *affinis*



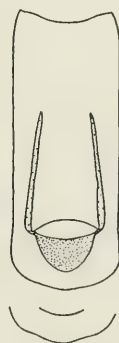
49 *hicoriae*



50 *falli*



51 *elegans*



52 *hayesi*



53 *aratus*

MS

## PLATE VI

## Dorsal View of Aedeagus

(including separate sketch of apex)

- FIG. 54.—*tibialis* n. sp.  
FIG. 55.—*nivosus* Lec.  
FIG. 56.—*seniculus* Lec.  
FIG. 57.—*crataegi* Walsh  
FIG. 58.—*adspersus* Lec.  
FIG. 59.—*naso* Lec.  
FIG. 60.—*posticatus* Boh.  
FIG. 61.—*geminatus* Lec.

- FIG. 62.—*cribricollis* (Say)  
FIG. 63.—*recessus* (Csy.)  
FIG. 64.—*crinaceus* Lec.  
FIG. 65.—*fissunguis* Lec.  
FIG. 66.—*tuberosus* Lec.  
FIG. 67.—*anaglypticus* (Say)  
FIG. 68.—*leucophaeatus* Fahr.



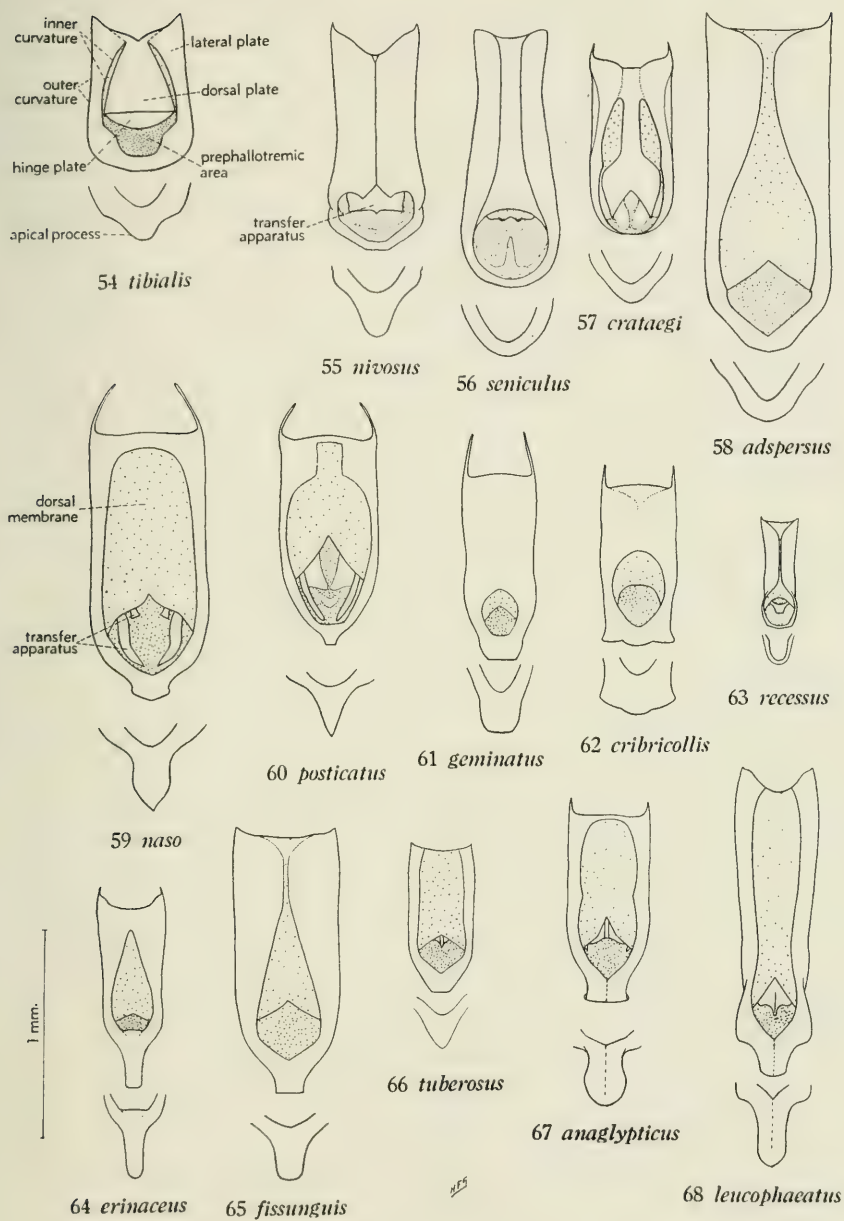
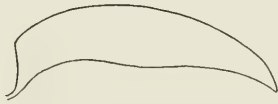
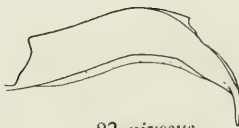
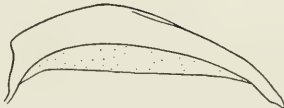
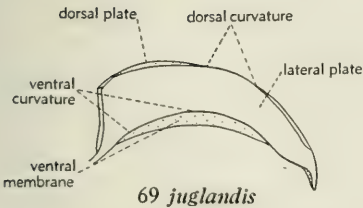


PLATE VI

## PLATE VII

## Lateral View of Aedeagus

- |                                   |                                  |
|-----------------------------------|----------------------------------|
| FIG. 69.— <i>juglandis</i> Lec.   | FIG. 77.— <i>falli</i> Blatch.   |
| FIG. 70.— <i>nemuphar</i> (Hbst.) | FIG. 78.— <i>elegans</i> (Say)   |
| FIG. 71.— <i>buchanani</i> n. sp. | FIG. 79.— <i>hayesi</i> n. sp.   |
| FIG. 72.— <i>albicinctus</i> Lec. | FIG. 80.— <i>aratus</i> (Germ.)  |
| FIG. 73.— <i>iowensis</i> n. sp.  | FIG. 81.— <i>tibialis</i> n. sp. |
| FIG. 74.— <i>retentus</i> (Say)   | FIG. 82.— <i>nivosus</i> Lec.    |
| FIG. 75.— <i>affinis</i> Boh.     | FIG. 83.— <i>seniculus</i> Lec.  |
| FIG. 76.— <i>hicoriae</i> n. sp.  |                                  |



1 mm.

HCS

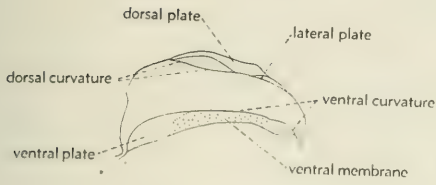
PLATE VII



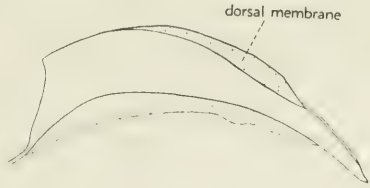
## PLATE VIII

## Lateral View of Aedeagus

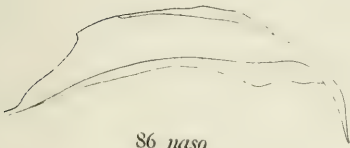
- |                                     |                                      |
|-------------------------------------|--------------------------------------|
| FIG. 84.— <i>crataegi</i> Walsh     | FIG. 90.— <i>recessus</i> (Csy.)     |
| FIG. 85.— <i>adspersus</i> Lec.     | FIG. 91.— <i>erinaceus</i> Lec.      |
| FIG. 86.— <i>naso</i> Lec.          | FIG. 92.— <i>fissunguis</i> Lec.     |
| FIG. 87.— <i>posticatus</i> Boh.    | FIG. 93.— <i>tuberosus</i> Lec.      |
| FIG. 88.— <i>geminatus</i> Lec.     | FIG. 94.— <i>anaglypticus</i> (Say)  |
| FIG. 89.— <i>cribricollis</i> (Say) | FIG. 95.— <i>leucophaeatus</i> Fahr. |



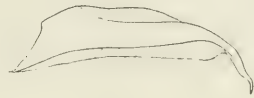
84 *crataegi*



85 *adspersus*



86 *naso*



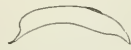
87 *posticatus*



88 *geminatus*



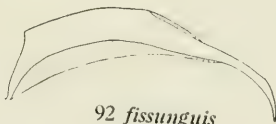
89 *cribricollis*



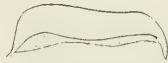
90 *recessus*



91 *erinaceus*



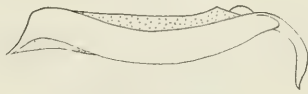
92 *fissunguis*



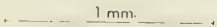
93 *tuberosus*



94 *anaglypticus*



95 *leucophaeatus*



2/5

## PLATE IX

- FIG. 96.—Posterior view of apical portion of left profemur, *naso* Lec. ♂, ♀.  
FIG. 97.—Posterior view of apical portion of left profemur, *carinifer* Csy. ♂, ♀.  
FIG. 98.—Posterior view of apical portion of left profemur, *posticatus* Boh. ♂, ♀.  
FIG. 99.—Dorsal view of aedeagus, *carinifer* Csy., including a separate sketch of apical process.  
FIG. 100.—Dorsal view of aedeagus, *carolinensis* n. sp., including sketches of two types of apical processes.  
FIG. 101.—Lateral view of head and beak, *carinifer* Csy. ♀.  
FIG. 102.—Lateral view of head and beak, *posticatus* Boh. ♀.  
FIG. 103.—Lateral view of aedeagus, *carinifer* Csy.  
FIG. 104.—Ventral view of a portion of aedeagus, *carolinensis* n. sp., to show the relative length and position of the J-shaped and elongate bars of the transfer apparatus; the loop of the J-shaped bar is directed toward the apex of the aedeagus.  
FIG. 105.—Lateral view of apical portion of beak, *carinifer* Csy. ♀, to illustrate distance (a) and distance (b).  
FIG. 106.—Lateral view of aedeagus, *carolinensis* n. sp.  
FIG. 107.—Ventral view of a portion of aedeagus, *anaglypticus* (Say), to show the relative length and position of the J-shaped and elongate bars of the transfer apparatus; the loop of the J-shaped bar is directed toward the apex of the aedeagus.  
FIG. 108.—Lateral view of apical portion of beak, *carinifer* Csy. ♂.  
FIG. 109.—Lateral view of apical portion of beak, *posticatus* Boh. ♂.



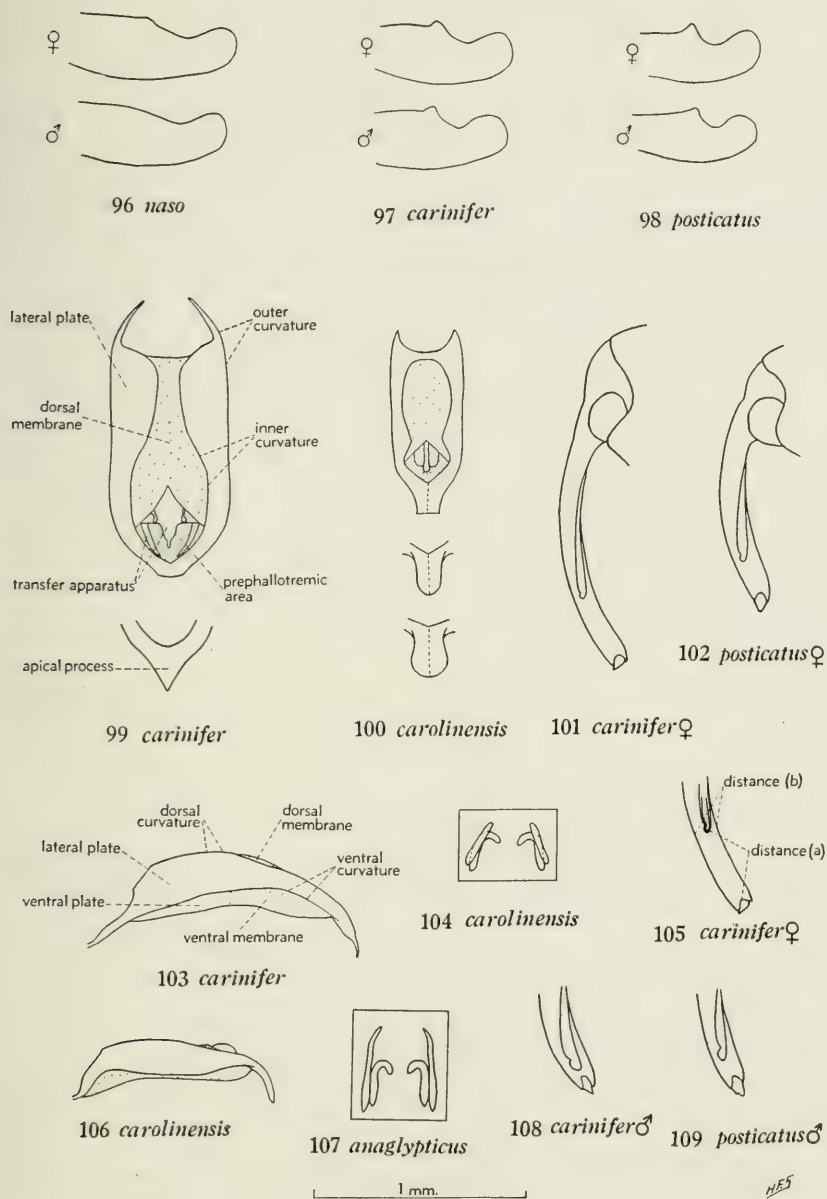


PLATE IX



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